

Section 9

Design Review

9.1 INTRODUCTION

The Master Developer shall administer all project submittals and approvals for development within Kyle Canyon. The procedure described below shall be used to administer the implementation process.

As an expression of the Master Developer's vision for Kyle Canyon, the Design Guidelines are intended to provide builders, architects, civil engineers, and others an overall direction in the design process. The criteria contained within the Design Guidelines provides examples of ways in which the vision can be achieved, however, the Master Developer strongly encourages creativity, innovation, and variety throughout Kyle Canyon. Builders may propose other design solutions to project development, as long as the overall intent of the community vision and Design Guidelines is achieved.

All project submittals, whether designed in strict accordance with the design criteria contained herein or with other design solutions not specifically addressed in the Design Guidelines, will be reviewed by the Master Developer to ensure that all projects achieve the goals and objectives of the Master Developer's vision as expressed throughout the Design Guidelines document.

9.2 IMPROVEMENTS REQUIRING REVIEW

All parcel improvements by the builder will require review and approval by the Master Developer. Improvements requiring review

include but are not limited to commercial and residential product including new construction, remodels, landscape, signage, and amenities such as parks, open play areas or community facilities and ancillary structures.

The Master Developer has the sole responsibility to enforce the Design Guidelines for all developments. The Master Developer shall review those developments and report to the City of Las Vegas prior to the City processing any building permit or subdivision map applications.

9.3 MASTER DEVELOPER REVIEW

The Master Developer along with its architectural consultants, landscape consultants, and civil engineering consultants shall review each project submittal. In addition, the Master Developer may consult with other professional advisors as deemed appropriate. Projects for design review shall be submitted to the Master Developer on a form to be prepared and updated from time to time by the Master Developer.

9.4 SUBMITTAL REQUIREMENTS

Two sets of the following items are required for submittal of production residential development plans prior to submittal to the City of Las Vegas. A Submittal Application and Checklist for Design Review must be submitted to the Master Developer (Refer to Figure 9-1).

Preliminary Concept Site Plan (Per Production Neighborhood; 1" = 40')

The purpose of this submittal is to ensure that the overall concept of the neighborhood design, particularly regarding the layout of proposed streets and lots, is consistent with the intent of the Design Guidelines *before* the builder begins preparation of tentative tract maps. The following are required elements of the Preliminary Concept Site Plan submittal:

- Conceptual street layout
- Conceptual lot layout

- Proposed pedestrian connections
- Adjacent streets and open space
- Accent material samples (Stone, Brick, Masonry, Etc.)
- Roof tile (Material and Color)

Detailed Development Plan (Per Production Phase; 1" = 40')

- Proposed street locations and dimensions
- Proposed lot lines and dimensions
- Proposed pedestrian connections
- Pre-plotting of units along parcel edges that are Adjacent to and Visible from a Public Place
- Building footprints (Model and elevation must be specified)
- Driveway and/or alley placement
- Wall and Fence locations and heights
- Adjacent street(s) and open space
- Location of all required parking

Landscape Plan (1" = 40')

- Street tree species, size and location
- Neighborhood entries
- Planting and fencing details

Architectural Plans

- Floor plans with dimensions (1/8" = 1' - 0" or 1/4" = 1' - 0")
- Elevations for all four sides with dimensions (1/8" = 1' - 0" or 1/4" = 1' - 0"). Material call-outs and depth of recesses or pop-outs should be identified
- Floor area calculations including 1st floor living area, 2nd floor living area, and garage square footage
- Typical lot for each floor plan indicating building footprint, setback requirements, driveway locations, and sidewalk locations.

Material and Color Sample Board (Maximum Size of Board(s): 11" x 17")

Actual samples mounted on boards of the following:

- Primary stucco material sample and color(s)
- Secondary stucco material sample and color(s)
- Accent and trim material sample and colors

Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST

**Project Plan
For Kyle Canyon Design Review**

POD #/Name: _____		Date: _____
Builder:		
Contact Name	_____	
Address	_____	
Telephone/Fax ()	()	()
Email	_____	
Architect:		
Contact Name	_____	
Address	_____	
Telephone/Fax ()	()	()
Email	_____	
Civil Engineer:		
Contact Name	_____	
Address	_____	
Telephone/Fax ()	()	()
Email	_____	
Landscape Architect:		
Contact Name	_____	
Address	_____	
Telephone/Fax ()	()	()
Email	_____	

• Please provide two (2) sets of each submittal along with this completed form and any other applicable documents to the address noted below.

Submit To:
Design Review Committee

Focus Property Group . 3425 Cliff Shadows Parkway, Suite 110 Las Vegas, Nevada 89129 . Phone: (702) 242-4949 . Fax: (702) 568-2044

Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST For Kyle Canyon Design Review

POD# _____ POD NAME: _____ PLAN DATE: _____

Detailed Development Plan

(Per Production Phase; 1" = 40')

Tentative Maps

- _____ Cross Section drawing that meets the requirements from the City of Las Vegas
- _____ Proposed street locations and dimensions
- _____ Proposed lot lines and dimensions
- _____ Proposed pedestrian connections
- _____ Sample building footprints (Model and elevation must be specified)
- _____ Sample driveway and/or alley placement
- _____ Wall and Fence locations and heights
- _____ Adjacent street(s) and open space
- _____ Location of all required parking
- _____ Proposed connections to water, sewer and storm drain facilities

Site Improvement Plan

- _____ Final grading
- _____ Grading details, all perimeter grading sections and details
- _____ Typical side corner grading sections on corner lots as appropriate to define all grading conditions
- _____ Storm drain improvements, storm drain inlet/outlet details along with any storm drain pipe profiles and wall/overflow opening details
- _____ Potable water improvements (Plan and profile)
- _____ Sanitary sewer improvements (Plan and profile)
- _____ Street lighting improvements
- _____ Paving plans with all appropriate street sections
- _____ Perimeter wall opening locations with dimensions
- _____ List of construction quantities
- _____ Final grading
- _____ Grading details, all perimeter grading sections and details
- _____ Typical side corner grading sections on corner lots as appropriate to define all grading conditions
- _____ Storm drain improvements, storm drain inlet/outlet details along with any storm drain pipe profiles and wall/overflow opening details
- _____ Potable water improvements (Plan and profile)
- _____ Sanitary sewer improvements (Plan and profile)
- _____ Street lighting improvements
- _____ Paving plans with all appropriate street sections
- _____ Perimeter wall opening locations with dimensions
- _____ List of construction quantities
- _____ Drainage study must be submitted with the first submittal of Improvement Plans.

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Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST

For Kyle Canyon Design Review

POD# _____ POD NAME: _____ PLAN DATE: _____

Final Map

(Please submit two (2) bond copies along with Mylar for approval)

_____ All information required by the City of Las Vegas as follows:

- Signed by owner and notarized
- Signed and stamped by Surveyor
- Name of proposed project
- Vicinity map
- Total acreage
- Total number of lots/lot & block numbers
- Lot sizes/dimensions/curve data information
- Street names/street widths
- Legend/north arrow/scale (each sheet)
- Adjacent Assessor's Parcel Numbers/record information/recorded dedications

_____ All necessary utility, ingress/egress, or sight visibility easements and right of way dedications across common lots. Final maps submitted for review without all appropriate easement/right-of-way information will be deemed incomplete.

_____ Any grant deeds required by the public agencies based upon information required in the preceding item.

Recorded Final Map

(Please submit documents below upon recordation)

- _____ One (1) full sized copy of the Recorded Final Map
- _____ Three (3) 11" x 17" copies of the Recorded Final Map

Three (3) copies of the addresses

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Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST

For Kyle Canyon Design Review

POD# _____ POD NAME: _____ PLAN DATE: _____

Plot Plan

Detailed Development Plan
(Per Production Phase; 1' = 40')

Preliminary Plot Plan (Drawing must be scaled)

- _____ Pre-plotting of units along parcel edges that are Adjacent to and Visible from a Public Place
- _____ Building footprints (typical, Model and elevation must be specified)
- _____ Setback requirements (typical)
- _____ Driveway locations and walls (typical)
- _____ Existing adjacent units with pad elevation and footprint/elevation identification
- _____ Legend or key diagram showing:

- All different building footprints in project
- Identification of each footprint by model number, one-story vs. two-story, plottable on corner lot or next to open space

Final Plot Plan (required for all lots adjacent to community exterior roadway)

(Please provide plot plans, approved pod final map base line work and associated x-ref's in DWG format as an electronic document to cshukis@fcglv.com. If the file size is too large to email please send a copy of the documents on CD.)

_____ Plot of individual lots or all lots showing:

- Building footprint
 - Building identification
 - Pad elevation – Finished floor.
 - Grading
 - Setbacks/Building Envelope
 - Product walls
 - Retaining walls
 - Driveways
 - Sidewalks
 - Existing adjacent units with pad elevation and footprint/elevation identification
- Legend or key diagram showing:
- All different building footprints in project
 - Identification of each footprint by model number, one-story vs. two-story, plottable on corner lot or next to open space

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Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST For Kyle Canyon Design Review

POD# _____ POD NAME: _____ PLAN DATE: _____

Architectural Plans

(Two (2) design submittal sets, each on a CD in a PDF format, and two (2) sets of hard-copies (half size 12"x18" sets 1/8" scale). Also include a copy of the approved site plan for reference.

- _____ Identify POD number on the title sheet of architectural package and/or on the title block of each page of the submittal
- _____ Provide separate submittal sets for each building type. (Minimum two (2) building types required for Single Family)
- _____ Identify building type (architectural style per plan) on the title sheet of each set and/or on each page of the submittal
- _____ Floor plan of each residence with dimensions (1/8" scale preferred or 1/4"). Dimensioned unit floor plans and building composites for attached and multi-family products
- _____ Floor plan modifications (if any) per architectural style
- _____ Wrap elevations with dimensions for each architectural style. (Label architectural style for each elevation)
- _____ Enhanced elevations for corner side and visible side and rear elevations
- _____ Elevation drawings for all four sides of each residence with material call-outs on all elevations
- _____ Photographs or sketches of front elevations (and side and rear elevations if visible from any street) of each residence
- _____ Material call-outs and depth of recesses or pop-outs should be identified
- _____ Floor area calculations (1st floor, 2nd floor, garage, porches, etc.) including living area per floor, total living area and garage square footage and sidewalk locations
- _____ Typical lot for each floor plan indicating building footprint, setback requirements, driveway locations

Figure 9-1

SUBMITTAL APPLICATION AND CHECKLIST For Kyle Canyon Design Review

POD# _____ POD NAME: _____ PLAN DATE: _____

Landscape Plan

- _____ Street tree species, size and location
- _____ Entry Plan, Neighborhood Entries
- _____ Entry wall locations and identification signage
- _____ Planting and fencing details
- _____ Common Area Plan
- _____ Typical lot landscape including all corner lots
- _____ Model homes landscape
- _____ Section drawings through landscaped drainage ways
- _____ Existing vegetation to be preserved

Landscape Materials Sample Board

- _____ Color chips
- _____ Manufacturer's cut sheets
- _____ Photographs and/or material samples for all landscape materials including, without limitation, walls, fences, textured paving, gravel mulch, site furnishings, stucco, paint, stain, and other visible exterior finishes

Landscape Construction Drawings

- _____ Construction and Drainage Plans
- _____ Irrigation plans
- _____ Planting plans with botanical and common names
- _____ Construction details with dimensions and specifications
- _____ Points of connection for water
- _____ Points of connection for power

Material and Color Sample Board (Maximum Size of Board(s): 11" x 17") – Actual samples mounted on boards of the following:

- _____ *Actual* Color chips for all color schemes
- _____ Manufacturer's cut sheets
- _____ Photographs and/or material samples for all building materials
- _____ Material and Color Board (maximum size of board(s): 11" x 17", preferred size: 8 1/2" x 11")
- _____ Noted or color coded elevations (front, side and rear)
- _____ Primary stucco material sample and color(s) (actual paint chip)
- _____ Secondary stucco material sample and color(s) (actual paint chip)
- _____ Accent and trim material sample and color(s) (actual paint chip)
- _____ Accent material sample(s) (stone, brick, masonry, etc.) (Manufacturer's printed picture)
- _____ Roof tile(s) (actual material and color samples)

Marketing Signage Plan

- _____ Illustrate layout and design details for all informational, directional, temporary and construction signage
- _____ Site plan showing location of signage

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KYLE CANYON

POD: _____

PLAN DATE: _____

TYPICAL RESIDENTIAL SUBMITTAL:

- Approved
- Approved with conditions
- Address Comments & Re-submit
- Incomplete
- Denied

PLEASE ADDRESS:

- Some plans listed are not on the approved plant palette. Please provide plant substitution/re-location requirements. Note: All trees and shrubs must be per the approved plant palette. If possible, coordinate with the adjacent streetscape planting.
- Provide botanical names for plant material.
- Identify/clarify irrigation controller location and any other above ground meters, transformers, etc.
- Drainage and grading is not indicated.
- Mound elevations must be shown on the plan.
- Boulder type should be specified on the plan.
- We strongly encourage the use of a xeriscape/drought tolerant palette.
- Only artificial turf allowed in front yards that are 250 sqft. minimum. Artificial turf must be Synlawn or an alternate must be submitted for review. Border should a minimum four inches of either concrete, grouted stone, masonry product or steel edging that is flush to grade. Specify materials on plan.
- Full coverage of granite mulch. Size and color must be indicated on plans. Granite colors to maintain consistent between lots and neighborhoods.
- River rock is discouraged and granite cobble is preferred.
- Two 24" box trees are required for each front yard.
- Trees should be spaced at least 15 feet apart, or if trees must be spaced closer, they should be the same small tree species.
- Trees to be set back a minimum of three feet on center from hardscape structures such as sidewalks, curbs, driveways, fences and walls.
- Shrub Density: 1-5 Gal and 1-1 Gal per 40 sqft. 1-1 Gal Accent per 125 sqft.
- Foundation planting must completely cover the visible portion of the houses base including all backflow preventer units. Planting to screen the areas of the house just above the finished grade as well as large expanses of wall.
- Each yard must contain at least five different plant species and no more than ten.
- Plants should be grouped and layered into flowing drifts to complement other plants of varying heights and textures.
- Access to rear yards at side yard must be maintained.
- Corner lots must have one 24" box tree per 30 linear feet along street and 60% plant coverage.
- Note total square footage of landscape area on plan.

OTHER:

KYLE CANYON

MULTI-FAMILY RESIDENTIAL SUBMITTAL:

- Approved
- Approved with conditions
- Address Comments & Re-submit
- Incomplete
- Denied

POD: _____

PLAN DATE: _____

PLEASE ADDRESS:

- Some plans listed are not on the approved plant palette. Please provide plant substitution/re-location requirements. Note: All trees and shrubs must be per the approved plant palette. If possible, coordinate with the adjacent streetscape planting.
- Provide botanical names for plant material.
- Identify/clarify irrigation controller location and any other above ground meters, transformers, etc.
- Drainage and grading is not indicated.
- Mound elevations must be shown on the plan.
- Boulder type should be specified on the plan.
- River rock is discouraged and granite cobble is preferred.
- Identify view corridor triangles at all cross traffic locations.
- Granite size and color must be indicated on plans. Parcel interiors must specify consistent granite color for common areas and front yards.
- Lawn is only allowed in park and recreation areas. Lawn must have a minimum 18" setback from curb and minimum width of 10'.
- We strongly encourage the use of a xeriscape/drought tolerant palette.
- Palms are not allowed.
- A minimum of one 24" box tree is required every 30 l.f. on center within landscape area in common areas and one 24" box tree for every 750 sq. ft. in recreational areas.
- Common areas must have a minimum of 75% vegetative coverage with a minimum of 50% of that coverage consisting of 5-gallon material.
- Multi-family parking lots must have:
 - A planting perimeter of 10'-0"
 - Perimeter landscape a minimum of one 24" box tree for every 30 .f. of landscape area.
 - A minimum of one 24" box tree for every 8 parking spaces.
- Landscape islands in parking areas shall have a minimum of one 24" box tree per parking stall depth.
- All non-paved areas within the perimeter and interior of parking lots shall be landscaped with a combination of plant materials and rock mulch.
- Parking visible from roadways and community open space shall be screened with a combination of berms, low walls or landscape.
- Maximum height of berms, walls and landscaping shall be 3'0" from the top of curb of the parking area for safety.

OTHER:

9.5 DESIGN REVIEW AND APPROVAL PROCESS

The Master Developer shall review each project submittal. The Master Developer shall make the final decision regarding approval of the submittal.

The Master Developer shall review each submission for the design's commitment to overall community development and adherence to these Design Guidelines. The Master Developer is not responsible for the review of submissions to determine conformance to any applicable codes and standards established by public agencies.

Submittals that are "Approved" by the Master Developer may then be submitted to the City of Las Vegas, if required. The Master Developer expects that its Development Agreement with the City will require city review of multi-family and commercial projects. Submittals that are "Approved with Conditions" or "Denied" shall be revised as necessary and re-submitted to the Master Developer for approval. All submittals must be approved by the Master Developer prior to submission to the City of Las Vegas or other public agencies.

9.6 ADMINISTRATION

9.6.1 AMENDMENT

The Design Guidelines may be amended from time to time by the Master Developer in accordance with the approved Development Agreement.

9.6.2 PREVALENCE OF DEVELOPMENT DECLARATION

In the event of any conflict between the provisions of the Design Guidelines and the Development Declaration, the most restrictive shall prevail.

9.6.3 MISCELLANEOUS

All items submitted during the review process shall become the property of the Master Developer. Changes to the approved plans shall be re-submitted to the Master Developer for approval and shall clearly identify the revision(s).

9.6.4 PROSECUTION OF WORK AFTER APPROVAL

After approval of the final plans by the Master Developer, the construction, alteration or other work described therein shall be commenced and completed in accordance with the rules set forth in these Design Guidelines and the Development Declaration. The Master Developer or its representative has the right to enter the lot or premises and to inspect the project for compliance with the Design Guidelines or Development Declaration at any time, without advance notice to the lot owner nor fear of trespass and liability.

9.6.5 VIOLATIONS

Construction deemed by the Master Developer to be in violation of approved drawings, the Design Guidelines, or the Development Declaration shall be corrected as described in the Development Declaration.

9.6.6 RECORDATION OF NOTICE

Upon approval of the final plans, the Master Developer shall, upon written request from the applicant, provide a statement of approval in a form appropriate for recordation. The Master Developer may also record a notice to reflect any work which has not been approved or any approval previously given which has been revoked.

9.6.7 RULE MAKING AUTHORITY

The Master Developer adopts these Design Guidelines for the purpose of interpreting, applying, supplementing and implementing the provisions of the Development Declaration pertaining to the design of site improvements. A copy of the Design Guidelines as from time to time adopted, amended or

revealed, shall be maintained in the office of the Master Developer and the City of Las Vegas, and shall be available for inspection during normal business hours by any applicant or any architect or agent of any such applicant. It shall be the responsibility of the applicant or architect or agent of any such applicant to inform themselves as to any and all such changes of these Design Guidelines.

9.6.8 LIABILITY OF COMMITTEE

Provided that the Master Developer acts in good faith, neither the Master Developer nor any representative thereof shall be liable to any applicant or any other person for any damage, loss or prejudice suffered or claimed on account of the review of any plans, specifications or materials. The review and delivery of a form of approval or disapproval is not to be considered an opinion as to whether or not the plans are defective or whether the construction methods or performance of the work proposed therein is defective, or whether the facts therein are correct or meet Las Vegas Building Codes.

9.6.9 PROFESSIONAL ADVICE

The Master Developer may employ the services of an architect, attorney, land planner, landscape architect or engineer to render professional advice and may charge the cost for services of such a professional to the applicant, but only after the applicant has been informed in advance such compensation shall be so charged.

Section 10

Glossary

As used in these Design Guidelines the following terms will have the definitions ascribed below:

Adjacent to and Visible from a Public Place means, with respect to any object, that such object is located within a parcel that abuts a Public Place and can be seen readily by a person of average height standing on the ground in a Public Place without the assistance of any optical aid such as a telescope or binoculars.

Alley means a road, whether public or private, that serves primarily as an access to garages.

Alley Zone means the landscapeable common area adjacent to any Alley.

Arroyo means the area shown on Figure 2-3, in which the natural washes will be preserved and enhanced.

Builder means the owner of any parcel within Kyle Canyon that proposes or commences any construction on such parcel. The term Builder refers to both Residential Builders and Non-Residential Builders.

Carriage Unit means living space on one or more floors immediately above a garage.

City means the City of Las Vegas.

Community Parks means the areas identified on Figure 2-3, which are to contain various recreational amenities.

Cul-de-Sac Streets means cul-de-sacs and other types of dead-end street segments and drive aisles serving multiple units.

Development Agreement means an agreement between the Master Developer and the City of Las Vegas regarding the development of Kyle Canyon, entered into pursuant to NRS 278.

Development Declaration means a Declaration of Development Restrictions recorded against a parcel of land within Kyle Canyon that imposes restrictions on the development of such land in favor of the Master Developer.

Development Parcel means each of the parcels shown on Figure 2-1, which are intended to be created as legal parcels.

Front-Drive Garage means a garage facing the street with a minimum recess of 5' from the façade of the principal building.

Master Developer means Kyle Acquisition Group, LLC.

Master HOA means a homeowner's association, the members of which shall be all owners of residential property within Kyle Canyon.

Mirador means a second story roofed living space that is integral to the floor plan. A roof element must cover 100% of the mirador floor area and shall consist of forms and materials that match the residence.

Multi-Family Home means a dwelling unit within a structure that is divided into more than one dwelling unit and in which one family or household lives above another or in which dwelling units do not have separate outside entrances.

Residential Parcel means each of the Neighborhood Residential Parcels, Urban Mixed-Use Parcels, and Town Center Mixed-Use Parcels shown on Figure 2-1 and any legal parcels created by a further subdivision of any such Residential Parcels that are intended to be developed into two or more residences or one or more non-residential structures by a single Builder.

Master CC&Rs means the Master Declaration of Covenants, Conditions & Restrictions for Kyle Canyon.

Neighborhood Streets means all of the roads within Kyle Canyon, whether public or private, other than the Village Streets. The Neighborhood Streets are to be constructed by the Builder of the Parcel.

Public Place means the right-of-way of a public street or sidewalk or a park area open to the general public.

Single Family Home means a dwelling unit for one household or family. The structure may be detached or attached to another dwelling unit. Attached dwelling units are considered Single Family Homes as long as the unit itself is not divided into more than one housing unit and has an independent outside entrance. Attached dwelling units that meet the foregoing definition are considered single family regardless of the legal form of ownership, whether condominium, cooperative or other form of ownership.

SNWA means the Southern Nevada Water Authority.

Story means the enclosed portion of a building between the surface of any floor and the surface of the floor next above it; or if there is not floor above it, then the space between the floor and the ceiling next above. Rooftop decks (covered or uncovered) shall not be considered a "story."

Town Center means the retail and mixed use areas within the West Side Urban District.

Village Streets means all of the roads within Kyle Canyon depicted on Figure 6-1 that are to be constructed by the Master Developer. The Village Streets are contrasted with the "Neighborhood Streets," which are to be constructed by the individual builders within each Neighborhood.

Section 11

Exhibits

- A. WATER SMART HOME STANDARDS AS OF JULY 1, 2006**
- B. 2006 INTERNATIONAL ENERGY CONSERVATION CODE
AS ADOPTED BY THE CITY OF LAS VEGAS**

EXHIBIT A

WATER SMART HOME STANDARDS AS OF JULY 1, 2006

SOUTHERN NEVADA WATER AUTHORITY



**Water Smart Homes Program
Homebuilder Participation Agreement**

This Agreement is made this _____ day of _____, 20____, by and between The Southern Nevada Water Authority and _____.
(Homebuilder Company Name)

WHEREAS:

The Southern Nevada Water Authority (the "Authority") offers a promotional program for Water Smart Homes ("Program"), and
The purposes of the Program are to establish minimum voluntary standards for water efficiency in new residential homes and communities and encourage consumers to select such homes, and
The homebuilder (Contractor) wishes to participate in the Program.

THEREFORE:

In consideration of the principles of the Program and of the mutual promises and agreements set forth in this Agreement and referenced addendums, the parties agree as follows:

GENERAL PROVISIONS

1. Commencement and Expiration of Agreement

The terms of this Agreement shall commence on the date of acceptance. The agreement shall be perpetual unless cancelled by written notice by either party. If there is an existing Water Smart Home Program agreement between the parties, this agreement will serve to supercede it.

2. Termination of Agreement

This Agreement may be terminated by either party, with or without cause by providing not less than thirty (30) days written notice to the other party of its intention to terminate. Contractor's sole remedy for any alleged breach of this agreement is termination pursuant to this provision.

3. Governing Laws

This Agreement and all rights, duties and obligations hereunder shall be governed by the laws of the state of Nevada and the city and/or county jurisdiction where the home design and construction is performed.

4. Assignment

The Contractor may not assign nor delegate any portion of this Agreement to a third party.

5. Indemnity

5.1 Contractor shall protect the property of the homebuyer and others at the work site or in the proximity of the work site. Contractor shall take all necessary precautions for the safety of employees at the work site. Contractor shall comply with all applicable provisions of federal, state and local safety laws and regulations to prevent accidents or injuries to persons or damage to property on or about or adjacent to the premises where the work is being performed.

5.2 Contractor agrees to indemnify and hold harmless any and all directors, officers, employees and agents of the Authority and any of its member agencies against all claims and demands arising out of:

- a. Injuries to persons, including deaths resulting therefrom and damage to property occurring at anytime during the term of this Agreement as direct or indirect result of the design and/or installation by Contractor, or negligence or omission by Contractor, its subcontractors, agents, employees.
- b. Contractor's fraudulent use or misrepresentation of this Program.

6. Independent Contractor

Contractor's participation in the Program shall be as an independent contractor and not as an agent or employee of the Authority or any of its member agencies.

7. Waiver

The failure or election of the Authority to enforce the terms and conditions of this Agreement or to exercise any right or privilege therein shall not be construed as a waiver of any other terms, conditions, rights or privileges.

8. Entire Agreement

8.1 This Agreement along with any and all documents incorporated by reference herein shall constitute the sole and entire Agreement and understanding between the parties as to the subject matter.

8.2 Any prior understandings, commitments or representations, expressed or implied between the parties shall not be construed to alter or waive any part of this Agreement.

PROGRAM PROVISIONS

9. Contractor as Principal

Contractor shall retain sole and principle responsibility for any and all work performed by subcontractors of Contractor pursuant to this Agreement.

10. License and Permit Requirements

10.1 Contractor shall hold all necessary licenses from all appropriate entities and governmental agencies in the state of Nevada, and applicable city and/or county jurisdictions as required.

10.2 Contractor warrants all such licenses are now and shall remain current and in good standing during the term of this Agreement.

10.3 Contractor shall obtain any and all permits or authorizations required to design and/or construct all homes, landscapes and relevant facilities.

11. Equipment and Performance Standards

The Contractor agrees to abide by all requirements and standards set forth in Agreement Addendum A and further agrees that the Authority may revise the requirements and standards by providing written notice to the contractor not less than 90 days prior to the effective date of the new requirements and standards. In the event the requirements and standards are changed during the construction of a project, the Contractor may elect to abide by either the requirements and standards in effect on the date the project was submitted to the Authority for inclusion in the Program, or by the standards in effect on the date of completion.

12. Training

12.1 The Contractor agrees to designate a primary designee as a point of contact. The designee and the following additional parties will be required to attend a program orientation of not more than two (2) hours. The Authority will determine class content.

- All construction managers
- All superintendents
- A representative from each plumbing and landscape subcontractor

At the Contractor's request, the Authority will provide supplemental training for the Contractor's sales and/or customer service representatives.

12.2 The Contractor's designee agrees to arrange and participate in a minimum of three mock inspections at three completed, unoccupied homes constructed by the Contractor. The appropriate construction manager or superintendent for the project must also attend. If any features fail in a mock inspection, an additional mock inspection will be required. This training requirement will be fulfilled when three successful inspections are recorded. There will be no charge for up to ten training inspections, after which, the Contractor will be charged the normal inspection fee.

12.3 At the Authority's discretion, the Contractor's designee may be required to attend an annual refresher training of not more than two (2) hours. The Authority will determine class content.

12.4 Costs incurred by Contractor for staff training (i.e. salaries, transportation) will be the sole responsibility of Contractor and will not be reimbursed by the Authority.

13. Use of SNWA's Water Smart Home Program Name and Logo

13.1 Only participating Contractors that have successfully completed training requirements in Section 12 may use the Program logo and materials in their advertising.

13.2 Use of the Program name, logo and materials does not constitute an endorsement of the Contractor.

13.3 No changes are permitted to the Program name and logo without express approval from the Authority.

13.4 All advertising by Contractor must include the State of Nevada Contractor's license number (Nevada Revised Statute 624.720(2)).

13.5 Upon termination of this Agreement by either party, Contractor must immediately cease and desist use of the Program name, logo and materials in their advertising.

13.6 Should this agreement be terminated for any reason, Contractor agrees that the SNWA may seek extraordinary relief in the form of a temporary restraining order, preliminary or permanent injunction requiring Contractor to cease use of SNWA program name and logo, and agrees that all legal conditions for that relief are met, including specifically a showing of irreparable harm to SNWA.

14. Customer Solicitation

14.1 The Authority will not provide any of its member agencies' customer information to Contractor for the purpose of solicitation or advertisement.

14.2 At its discretion, the Authority will provide promotional and advertising support through mediums such as but not limited to its web site, newsletters, news releases, decals, and collateral materials for Contractor to promote their participation in the Program.

15. Customer Disputes

15.1 At its discretion, the Authority may investigate Contractor compliance with the Requirements and standards set forth in Addendum A of this Agreement.

15.2 Contractor shall be solely responsible for the resolution of any and all disputes between customer and Contractor. Failure to resolve disputes may result in removal of Contractor from the Program.

16. Exclusive Benefit of the Parties

16.1 This Agreement is not intended to create any rights, powers or interest in any third party and is made and entered into for the exclusive benefit of "the Authority" and "SNWA".

17. Non-discriminatory Employee Practices

17.1 The Contractor shall not employ discriminatory practices in the provision of services, employment of personnel, or in any other respect on the basis of race, color, religion, sex, national origin, ancestry, or physical or mental handicap. During the performance of this Agreement the Contractor agrees as follows:

No person in the United States shall, on the grounds of race, color, religion, national origin, sex or sexual preference, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity made possible by or resulting from this Agreement.

The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual preference, national origin, ancestry, or physical or mental handicap. The Contractor shall take affirmative action to ensure that applicants are employed, and the employees are treated during employment, without regard to their race, color, religion, sex, national origin, ancestry, or

physical or mental handicap. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provision of this nondiscrimination clause.

The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual preference, national origin, ancestry, or physical or mental handicap.

The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice advising the said labor union or workers representatives of the Contractor's commitment under this Section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

Contractor

Contractor License Number

Contractor Company Name

Representative Name

Representative Title

Representative Signature

Date:

Southern Nevada Water Authority

Representative Name

Representative Title

Representative Signature

Date:

Agreement Addendum A Water Smart Home Program

Annual Fee

To participate, Contractor must pay an annual fee based upon the number of homes built in the calendar year preceding the effective date of the agreement. The annual fee schedule is as follows:

\$2,000 per Contractor, plus
\$5 per home sale transaction closed the previous calendar year. Only dwellings with land use codes 110 and 160 will be used in calculating the fee.

The fee is payable on or before the effective date of this agreement. The annual fee shall be for the period of March 1 through February 28 (or February 29, when appropriate). In the event a contractor enrolls in the program after the year has commenced, the fee shall be prorated based upon the number of days remaining. Notices of fee renewal shall be issued in March of each year. Payment is due 30 days from the invoice date.

All annual fees will be used to market the program. The annual fee is not refundable if the Contractor elects to terminate the agreement. In the event the Authority terminates the agreement, the Contractor will receive a pro-rated refund based upon the number of days remaining in the agreement period.

Inspections and Inspection Fees

For the purpose of inspecting for Program compliance, the Contractor agrees to allow the Authority reasonable access to any home, structure or landscape area submitted to receive a Water Smart designation. The Contractor may request a compliance inspection at any point in the construction process provided that all of the required items are completed and functional at the time of inspection.

The Authority reserves the right to select a sample of homes and/or common areas for inspection. The quantity of homes inspected will comprise not less than ten percent (10%) of the total number of homes submitted by the Contractor in any subdivision or subdivision phase. If two to ten homes are submitted, at least two shall be inspected. If only one home is submitted it will be inspected. All community buildings will be required to be inspected in addition to the required home inspections.

The Contractor agrees to pay the Authority \$100.00 for each home or community structure inspected. The Authority will bill the Contractor for inspections on a quarterly basis. Payment is due 30 days from the invoice date. If payment is not received within 35 days, a second notice shall be issued. If payment is not received within 60 days of the first invoice, inspections shall be suspended and the Contractor may be suspended from the program until the account is paid in full.

Any home that fails to meet the program requirements shall be subject to reinspection by the Authority at the Contractor's expense.

Program Participant Designations

There are two designations:

Water Smart Home
Water Smart Neighborhood

The participating homebuilder may use either of the two designations by meeting the qualifying standards for each.

Water Smart Home - A single-family home or townhome constructed by a participating builder that is built to meet the minimum standards established by SNWA.

Water Smart Neighborhood- A multi-home development of homes and/or townhomes constructed by a participating builder wherein all of the dwellings are Water Smart Homes and the common area landscapes and structures meet minimum standards established by SNWA.

**Technical Standards for Single-Family Homes and Townhomes
Water and Sewer Service**

Water Smart Homes must meet all the following prerequisites:

- Single-family homes and townhomes with Land Use Codes of 110 and 160.
- Individually metered to receive water from a member agency of the Southern Nevada Water Authority.
- Discharge all wastewater to a public sewer system.

Quality of installation

All components must be properly installed. The Authority may reject or require corrective action on any home with devices improperly installed, or where any components are determined to be defective or malfunctioning prior to occupancy. The Authority may reject any home where it is determined that a leak, seen or unseen, exists in the plumbing system at the time of inspection.

Landscape Design

All landscapes and irrigation work performed by the homebuilder or their subcontractor is guaranteed to comply with applicable laws and codes in effect at the time of installation.

No turf will be used in front yards. If the builder offers backyard landscaping, turf will not exceed 50 percent of the total landscapable area of the back yard, or 1,000 square feet, whichever is less. If a pool and/or spa are installed prior to owner occupancy, the water surface area will be deducted from the turf allowance. Homebuyers will have an option to select turf varieties with greater water efficiency, such as improved varieties of Bermuda, Zoysia, Buffalo and other warm-season grasses. Ryegrass, Bluegrass, Bentgrass and Dichondra lawns are prohibited.

Builders will not install or facilitate installation of ornamental water features except as allowable components of a swimming pool or spa.

Irrigation System Standards

The Contractor guarantees that all irrigation systems, if properly operated and maintained, can sustain the landscape without creating flow or spray that leaves the property. Irrigation systems shall meet the following standards:

Compliance Criteria for Irrigation Systems

Type of irrigation system	Minimum continuous operating duration without generating spray or flow off property
Pop-up, fixed-spray sprinklers	7 minutes
Rotor sprinkler heads	20 minutes
Drip irrigation	30 minutes
Subsurface irrigation	10 minutes
Flood bubblers	10 minutes

On all new landscape installations, separate control zones (valves) will be used for each type of watering device. For example, drip emitters will be operate separately from sprinkler heads.

Sprinkler heads will be used only to water turfgrass (where allowed) and will have a 4" or greater pop-up height and matched precipitation nozzles.

Drip irrigation systems will be equipped with a pressure regulator, filter, flush end assembly and any other appropriate components. Components will be accessible for maintenance.

Contractor-provided irrigation controllers will have the following minimum features:

- Two or more programs
- Three or more start times per program
- One-minute incremental watering time
- Even/odd day scheduling
- Day interval scheduling
- Day of week scheduling
- Capable of accepting external soil moisture and/or rain sensors
- Non-volatile memory or self-charging battery circuit

A seasonal watering schedule for each zone will be posted at the controller.

An owner's manual will be provided for all irrigation controllers and other irrigation components.

Non-turf areas will include a minimum 2-inch layer of mulching material. If weed barrier fabric is used, it will be permeable to air and water. Permeable grade artificial turf may be used to meet the mulch requirement.

A one-year limited warranty will be offered on builder-installed landscaping. Terms of the warranty are at the discretion of the builder. The warranty must be provided to the homebuyer.

Swimming Pools and Spas

Even if no pool or spa is installed by the builder, all homes must be equipped to facilitate the draining of pool and spa water to the sanitary sewer.

Each dwelling shall have an exterior sewer cleanout downstream of all other sewer connections for the structure and located inside an enclosure. Enclosures must be adequately sized and shaped to allow reasonable access to use tools to remove the cap from the pipe. The enclosure lid must be clearly and permanently marked "SEWER." The words "POOL DRAIN" may be added at the Contractor's discretion.

Pool and spa water surface areas will be deducted from the maximum allowable turf area. The combined area of turf and open water may not exceed 1,000 square feet.

Pools may not feature decorative water features that drop or propel water more than 24 inches above the main water surface.

Minimum Plumbing Standards

Service pressure for all uses (indoor and outdoor) must be 60 psi or less. Compliance may be achieved by use of a pressure-regulating valve (PRV) downstream of the water meter. In the event static water pressure is at or below 60 psi, no PRV is necessary. All fixtures and irrigation system connections must be downstream of the pressure regulator.

All plumbing fixtures must be UPC approved.

High-efficiency indoor plumbing fixtures

Toilets 1.6 gallons maximum per flush.

Kitchen faucets 2.2 gallons per minute (gpm) maximum

Bathroom faucets 1.5 gallons per minute (gpm) maximum

Shower fixtures - Total water output for shower heads and similar devices may not exceed 2.5 gallons per minute (gpm) maximum. If the device has multiple nozzles (such as a body spray unit), the collective volume of all nozzles the user may operate simultaneously may not exceed 2.5 gallons per minute. If the contractor intends to design a shower facility for more than one person, the design and fixtures must be reviewed and approved by the Authority. Under no circumstance will any facility be approved where water flow may exceed 2.5 gpm per user.

Hot water recirculating systems, point of use water heating devices, or manifold systems are required to minimize water loss during hot water delivery.

Appliance Standards

If the following types of appliances are offered, financed, installed, or sold as upgrades through the Contractor, they must meet these standards:

Dishwasher - May not exceed 7.0 gallons per normal cycle. Effective January 1, 2007, the maximum water use will be 6.5 gallons per normal cycle;

Washing Machines – Must be high-efficiency models with an Energy Star water factor (WF) not to exceed 8.5 gals per cubic foot capacity. Effective January 1, 2007 the maximum allowable WF will be 7.0.

Water Softener – All devices must be certified to meet the NSF/ANSI 44 standard. All water softeners must be demand-initiated regeneration. Devices that use autoinitiated regeneration (fixed schedule) are prohibited. If the device uses an ion exchange technology, it must be capable of using potassium rather than sodium salt.

Drinking Water Treatment – Drinking water treatment systems using distillation, adsorption, reverse osmosis or ultraviolet processes must be certified to meet applicable NSF/ANSI certifications. Such systems must have an efficiency rate of not less than 85 percent (minimum of 85 gallons of water available for beneficial use within the home for every 100 gallons of water input to the device). Discharge water diverted for another code-approved use within the home may be considered a beneficial use at the discretion of the Authority.

Air Conditioning Systems

All air conditioning systems must be non-evaporative systems with zero net consumptive water use.

Standards for Water Smart Neighborhoods

All homes and community buildings must meet the applicable minimum standards for Water Smart Homes.

In addition to meeting the standards of a Water Smart home, common area landscapes are also subject to the following provisions:

Turf will be used only in functional community recreational areas that meet the following minimum standards:

1. No turf areas of less than 50 feet in any dimension.
2. At the Contractor's expense, sprinkler irrigation systems must be validated to meet an average minimum distribution uniformity of 65 percent. All testing and verification shall be conducted by an independent Certified Landscape Irrigation Auditor with credentials from the Irrigation Association. Documentation is required.

The combined surface area of community pools and spas may be up to 20 square feet for each dwelling with pool access. Communities of 50 dwellings or less may have community pool facilities with a combined surface area of up to 1,000 square feet.

Recreational water features, such as water play facilities, must be user-activated and may not be single-pass use (water used going directly to sewer). The area of such features will be deducted from the allowable surface area of swimming pools.

Compliance With Code

In the event that any standard or requirement in this agreement conflicts with local code requirements, the local code shall prevail.

EXHIBIT B

**2006 INTERNATIONAL ENERGY CONSERVATION CODE
AS ADOPTED BY THE CITY OF LAS VEGAS**

- A) The publication entitled "International Energy Conservation Code, 2006 Edition," as published by the International Code Council, and
- B) The document entitled "Southern Nevada Amendments to the 2006 International Energy Conservation Code," which adds to, deletes from and amends the "International Energy Conservation Code, 2006 Edition."

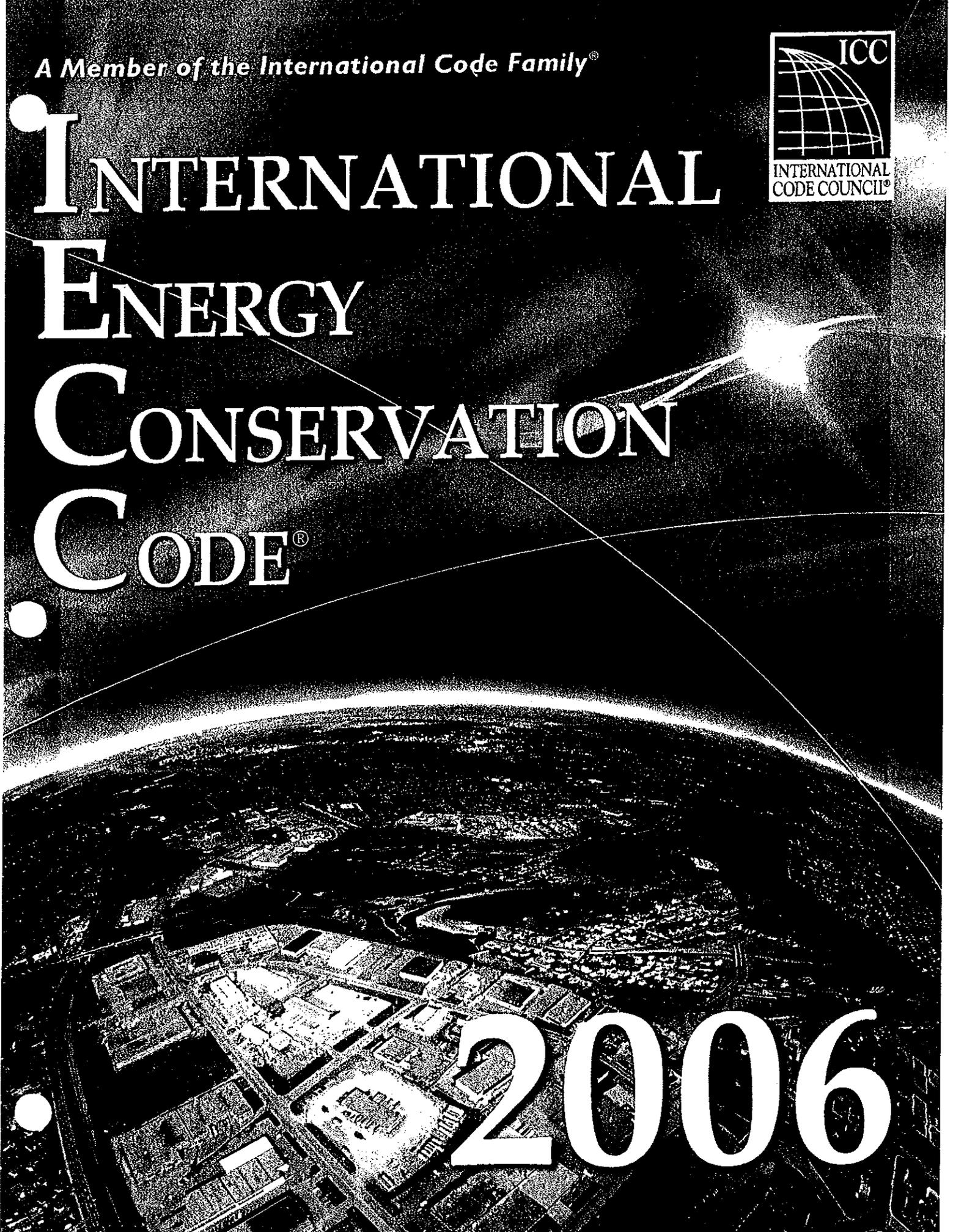
(Available on CD)

A Member of the International Code Family®



INTERNATIONAL ENERGY CONSERVATION CODE®

2006



1 **BILL NO. 2006-76**

2 **ORDINANCE NO. 5882**

3 AN ORDINANCE TO ADOPT THE 2006 EDITION OF THE INTERNATIONAL ENERGY
4 CONSERVATION CODE, ALONG WITH AMENDMENTS THERETO, AND TO PROVIDE FOR
OTHER RELATED MATTERS.

5 Proposed by: Paul Wilkins, Director of Building
6 and Safety

Summary: Adopts the 2006 Edition of the
International Energy Conservation Code, along
with amendments thereto.

7 THE CITY COUNCIL OF THE CITY OF LAS VEGAS DOES HEREBY ORDAIN
8 AS FOLLOWS:

9 SECTION 1: Title 16, Chapter 52, Section 10, of the Municipal Code of the City of
10 Las Vegas, Nevada, 1983 Edition, is hereby amended to read as follows:

11 **16.52.010:** Those certain documents, three copies of which are on file in the Office of the City
12 Clerk and are designated as follows, are adopted by reference as if set forth herein in full:

13 (A) The publication entitled ["International Energy Conservation Code, 2003
14 Edition,"] "International Energy Conservation Code, 2006 Edition," as published by the International
15 Code Council, as Part 1 of this Chapter; and

16 (B) The document entitled ["2003 Southern Nevada International Energy
17 Conservation Code Amendments,"] "Southern Nevada Amendments to the 2006 International Energy
18 Conservation Code," which adds to, deletes from and amends the ["International Energy Conservation
19 Code, 2003 Edition,"] "International Energy Conservation Code, 2003 Edition," as Part 2 of this
20 Chapter.

21 SECTION 2: The document entitled "Southern Nevada Amendments to the 2006
22 International Energy Conservation Code," referred to in Section 1 of this Ordinance, is attached
23 hereto.

24 SECTION 3: The documents entitled "International Energy Conservation Code, 2003
25 Edition" and "2003 Southern Nevada International Energy Conservation Code Amendments" are
26 hereby repealed.

27 SECTION 4: If any section, subsection, subdivision, paragraph, sentence, clause or
28 phrase in this ordinance or any part thereof is for any reason held to be unconstitutional or invalid or



1 ineffective by any court of competent jurisdiction, such decision shall not affect the validity or
2 effectiveness of the remaining portions of this ordinance or any part thereof. The City Council of the
3 City of Las Vegas hereby declares that it would have passed each section, subsection, subdivision,
4 paragraph, sentence, clause or phrase thereof irrespective of the fact that any one or more sections,
5 subsections, subdivisions, paragraphs, sentences, clauses or phrases be declared unconstitutional,
6 invalid or ineffective.

7 SECTION 5: Whenever in this ordinance any act is prohibited or is made or declared
8 to be unlawful or an offense or a misdemeanor, or whenever in this ordinance the doing of any act is
9 required or the failure to do any act is made or declared to be unlawful or an offense or a
10 misdemeanor, the doing of such prohibited act or the failure to do any such required act shall
11 constitute a misdemeanor and upon conviction thereof, shall be punished by a fine of not more than
12 \$1,000.00 or by imprisonment for a term of not more than six months, or by any combination of such
13 fine and imprisonment. Any day of any violation of this ordinance shall constitute a separate offense.

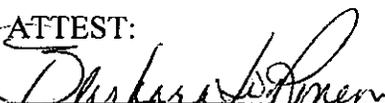
14 SECTION 6: All ordinances or parts of ordinances or sections, subsections, phrases,
15 sentences, clauses or paragraphs contained in the Municipal Code of the City of Las Vegas, Nevada,
16 1983 Edition, in conflict herewith are hereby repealed.

17 PASSED, ADOPTED and APPROVED this 17TH day of January, 2007.

18 APPROVED:

19
20 By 
21 OSCAR B. GOODMAN, Mayor

22 ATTEST:


23 BARBARA JO RONEMUS, City Clerk

24 APPROVED AS TO FORM:

25 Val Stead 12-7-06
26 Date

1 The above and foregoing ordinance was first proposed and read by title to the City Council
2 on the 20th day of December, 2006, and referred to a committee for recommendation;
3 thereafter the committee reported favorably on said ordinance on the 17th day of January,
4 2007, which as a regular meeting of said Council; that at said regular meeting, the
5 proposed ordinance was read by title to the City Council as first introduced and adopted by
6 the following vote:

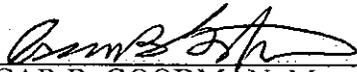
7 VOTING "AYE": Mayor Goodman and Councilmembers Reese, Brown, Weekly,
8 Wolfson, Tarkanian and Ross

9 VOTING "NAY": None

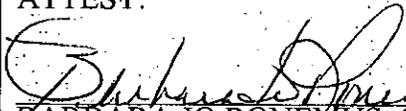
10 EXCUSED: None

11 ABSTAINED: None

12
13 APPROVED:

14 
15 _____
16 OSCAR B. GOODMAN, Mayor

17 ATTEST:

18 
19 _____
20 BARBARA JO RONEMUS, City Clerk
21
22
23
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25
26

Southern Nevada Amendments

To The

2006

International Energy Conservation Code

Published: October 12, 2006

Clark County 4701 W. Russell Road Las Vegas, NV 89118 (702) 455-3030 Inspections: 455-8040	City of Las Vegas 731 S. 4 th Street Las Vegas, NV 89101 (702) 229-6251 Inspections: 229-2071
Boulder City 401 California Ave. Boulder City, NV 89005 (702) 293-9282	City of Mesquite 10 East Mesquite Blvd. Mesquite, NV 89027 (702) 346-2835
North Las Vegas 2240 Civic Center Drive North Las Vegas, NV 89030 (702) 633-1577 Inspections: 633-1576	City of Henderson 240 Water Street Henderson, NV 89015 (702) 267-3600 Inspections: 267-3900
Pahrump Regional Planning District 1210 E. Basin Suite 1 Pahrump, NV 89060 (775) 751-3773	

Preface

This document comprises the proposed Southern Nevada Amendments to the 2006 International Energy Conservation Code as published by the International Code Council (ICC). It was developed by the jurisdictions listed on the cover page, the Southern Nevada Home Builders Association (SNHBA), representatives of the building industry (both contractors and trade groups), representatives of private energy consulting groups, and consultants representing the State Energy Office and DOE as a document to be adopted by reference. These provisions are not intended to prevent the use of any material or method of construction not specifically prescribed herein, provided any alternates have been approved and its use authorized by the building official. This document is available to be adopted as code by any jurisdiction without permission or approval from the jurisdictions listed on the cover page.

101.1 Title.

Section 101.1 is amended to read:

101.1 Title. This code shall be known as the Energy Conservation Code of Southern Nevada, and shall be cited as such. It is referenced to herein as "this code."

101.4.3 Additions, alterations, renovations or repairs.

Revise Sec. 101.4.3 to add Exceptions #5 and #6, so that the section reads as follows:

101.4.3 Additions, alterations, renovations or repairs. Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations, or repairs shall not create an unsafe or hazardous condition of overload existing building systems.

Exception: The following need not comply provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Glass only replacements in an existing sash and frame.
3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Relocations of existing luminaries within an existing space.
6. Alterations that replace 50% or less of the luminaries within a space, provided that the total energy consumption of the new luminaries is at least 10% less than the total energy consumption of the luminaries being replaced. If this exception is taken, the design professional shall provide all necessary calculations and information on the plans to show justification.

101.5.2.1 Low Energy Buildings.

Section 101.5.2 is amended to read:

101.5.2 Low energy buildings. The following buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this code shall be exempt from the building thermal envelope provisions of this code:

1. Those with a peak design rate of energy usage less than 3.4 Btu's /h/ft² (10.7W/m²) or 1.0 watt/ft² (10.7W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Those spaces that employ evaporative cooling as the sole source of conditioning.
4. Spaces whose sole purpose is to house and protect from freezing risers and mechanisms directly related to the building fire suppression system.

107.3 Referenced Codes.

Add a new section 107.3 to read:

107.3 Referenced Codes. Where this code refers to other codes not adopted by the jurisdiction, the applicable code adopted by the jurisdiction shall govern.

202 General Definitions.

Add the following definition:

AIR BARRIER: An integral component of the thermal energy envelope comprised of approved solid opaque materials that supports in-contact insulating material on one side and is sealed to prevent any leakage of air through the building enclosure. The air barrier can be comprised of, but not limited to, the exterior siding, exterior lath and stucco, rigid insulation board, exterior sheathing and sub-sheathing, water proof substrate with tiles, masonry or stone veneers, roof sheathing and drywall between conditioned and unconditioned attic spaces.

Revise the definition of BUILDING THERMAL ENVELOPE to read as follows:

BUILDING THERMAL ENVELOPE: The basement walls, exterior walls, floor, roof and any other building element comprised of a solid air barrier and approved insulation components in substantial, direct contact with it, that encloses conditioned space and any exempt or unconditioned space.

Add the following definitions in alphabetical order:

CASINO RESORT-BACK OF HOUSE: Areas of a casino resort that are only accessible to authorized personnel and not to the general public and guests, such as employee and delivery entrances, employee lounges and dining areas, administrative offices and meeting rooms, maintenance areas, storage rooms, service corridors, etc.

CASINO RESORT-FRONT OF HOUSE: Areas of the casino resort that are physically accessible or visible to the general public and guests, such as the exterior facades, landscaping, entries, lobbies, guestroom corridors, porte cocheres, retail shops,

restaurants, theaters, gaming areas, guest conference and meeting rooms, other areas of entertainment, etc.

Delete the definition of **CONDITIONED SPACE** and replace it with the following definition:

CONDITIONED SPACE: For energy purposes, space within a building that is provided with heating and/or cooling equipment, un-insulated ducts or systems capable of maintaining, through design or heat loss/gain, 50° F (10°C) during the heating season and 85° (29° C) during the cooling season, or through openings that communicate directly with a conditioned space. For mechanical purposes, an area, room or space being heated or cooled by any equipment or appliance. Note: Spaces which utilize required supplemental heating for the sole purpose of protecting wet fire protection systems (freeze protection to 42° F) or whose sole source of conditioning is through evaporative cooling is **not** considered conditioned space for the purposes of this code.

Add the following definitions in alphabetical order:

DISPLAY KITCHEN: A substantially open cooking and food preparation facility, located in the front-of-house dining room/lounge area specifically for the purpose of entertaining patrons by demonstrating the function of food and drink preparation.

INSULATION -- THERMAL: A component of the thermal energy envelope comprised of any approved material installed in substantially direct contact to either side of the air barrier that provides measured thermal resistance (R-value) to heat flow from a conditioned space to which it bounds.

LIGHTING -- SPECIALIZED MEDICAL, DENTAL AND RESEARCH: Lighting, other than general room illumination lighting, that is supplied from specialized single-purpose fixtures that are essential for the performance of specific medical, dental, or research-related tasks or procedures, including low-level night-lights used in clinical applications.

LIGHTING – TASK: Lighting provided to illuminate work areas wherein specific repetitive and/or ongoing tasks or operations are performed. To be considered task lighting, the fixture(s) providing the illumination must be either cord-and-plug connected or hard-wired apart from the fixtures specified for general lighting and be switched or dimmed locally. Tasks that commonly require additional illumination include drafting; graphic design; office duties such as filing and sorting mail; reading detailed photographs, carbon copies, handwritten documents, materials printed with less than 6-point type, maps, and telephone books; maintenance work; and industrial tasks such as cutting, crushing, sorting, or grading; manufacturing components; machining; difficult or exacting assembly; difficult or exacting inspection; welding; and crafting by means of engraving, carving, painting, stitching, cutting, pressing, knitting, polishing, or woodworking. Authorities having jurisdiction may approve additional qualifying tasks.

LIGHTING -- THEATRICAL AND SPECIAL EFFECTS: Theatrical lighting shall be any lighting used to directly or indirectly illuminate a stage or other performance area, including dance floors. Special effects lighting shall be lighting used within or as part of a visual feature in a themed or theatrical environment. Special effects lighting shall

include but not be limited to: strobe lights, automated luminaries (intelligent lighting), effects projectors, and ultraviolet (UV) fixtures. In order to qualify as theatrical or special effects lighting, the lighting must be separated from general illumination and be operated from a control system accessible only by authorized personnel.

MASS WALL: Walls constructed of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth), or solid timber logs.

SIGN: An interior or exterior lighted device used to impart way-finding, identifications or promotional information to the viewer. Signs include, but are not limited to, business identification, locations maps and directories, gaming boards, sports scoreboards, and slot carousel identifiers.

401.3 Certificate.

Section 401.3 is amended to read:

401.3 Certificate. A permanent certificate shall be posted in a conspicuous place on or in the home. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominate *R*-values of insulation installed on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration; and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.

402.4.1 Building Thermal Envelope.

Section 402.4.1 is amended to read:

402.4.1 Sealing of air barrier. The building air barrier shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an approved material:

1. All joints, seams, and penetrations in the air barrier.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Other sources of infiltration through the air barrier.

403.2.1 Insulation.

Section 403.2.1 is amended to read:

403.2.1 Insulation. Supply and return ducts shall be insulated to a minimum of R-6. Ducts in floor trusses shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

403.2.2 Sealing.

Section 403.2.2 is amended to read:

403.2.2 Sealing. All ducts, filter boxes, and building cavities used as ducts shall be sealed. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing or other approved closure systems. Closure systems used with rigid fibrous glass ducts shall comply with UL 181A and shall be marked "181A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape. Closure systems used with flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181B-FX" for pressure-sensitive tape or "181 B-M" for mastic. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Crimp joints for round metal ducts shall have a contact lap of at least 1 ½ inches (38mm) and shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint.

403.4 Circulating Hot Water Systems.

Section 403.4 is deleted and replaced with the following:

403.4 Hot water systems. All service hot water heating systems shall meet the requirements of Section 403.4.1 or Section 403.4.2.

403.4.1 Non-circulating hot water systems. All service hot water piping installed in unconditioned spaces, including under-slab piping, shall be insulated to R-2.

403.4.2 Circulating hot water systems. All circulating service hot water piping, including under-slab piping, shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

403.5 Mechanical Ventilation.

Section 403.5 is amended by adding an exception, so that the section reads as follows:

403.5 Mechanical ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Exception: Where clothes dryer exhaust vents terminate at the roof, backdraft dampers are not required.

404.3 Performance-based Compliance.

Sec. 404.3 is deleted and replaced with the following:

404.3 Site energy: The different energy sources shall be compared on the basis of source energy used at the site where 1kWh=10,239 Btu.

404.6.1 Minimum Capabilities.

Section 404.6.1 is amended to read:

404.6.1 Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

1. Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure shall not allow the user to directly modify the building component characteristics of the standard reference design.
2. Calculation of whole-building (as a single zone) sizing for the heating and cooling equipment in the standard reference design residence shall be sized based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air conditioning equipment based on climate and equipment sizing.
4. Printed code official inspection checklist listing each of the proposed design component characteristics from Table 404.5.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (e.g. R-Value, U-Factor, SHGC, HSPF, AFUE, SEER, ER, etc.).

502.4.4 Outdoor Air Intakes and Exhaust Openings.

Section 502.4.4 is amended by adding exceptions 2-6, so that the section reads as follows:

502.4.4 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s Cm²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

Exceptions:

1. Gravity (non-motorized) dampers are permitted to be used in buildings less than three stories in height above grade.
2. Supply and exhaust ducts or shafts integral to the smoke management system as required by Section 909 of the International Building Code.
3. Type I and Type II hoods in commercial kitchens and the make-up air units that are required for the operation of these fume hoods.
4. All vents used for conveying products of combustion.
5. Clothes dryer vents that terminate at the roof.
6. Explosion venting.

502.4.6 Vestibules.

Section 502.4.6 is amended by adding exception 7, so that the section reads as follows:

502.4.6 Vestibules. A door that separates conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time.

Exceptions:

1. Buildings in Climate Zones 1 and 2 as indicated in Figure 301.1 and Table 301.1.
2. Doors not intended to be used as a building entrance door, such as doors to mechanical or electrical equipment rooms.
3. Doors opening directly from a sleeping unit or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m²) in area.
5. Revolving doors.

6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. Doors in buildings with less than four stories above grade.

505.2.2.1 Light Reduction Controls.

Section 505.2.2.1 is amended to read:

505.2.2.1 Light reduction controls. Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Lighting reduction shall be achieved by one of the following or other approved method:

1. Controlling all lamps or luminaires;
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps;
3. Switching the middle lamp luminaires independently of the outer lamps;
4. Switching each luminaire or each lamp; or
5. Using a dimming control system to reduce load by at least 50 percent.

Exceptions:

1. Areas that have only one luminaire.
2. Areas that are controlled by an occupant-sensing device.
3. Corridors, storerooms, restrooms, public lobbies, or means of egress.
4. Sleeping unit (see Section 505.2.3).
5. Spaces that use less than 0.6 Watts per square foot (6.5 W/m^2).

505.2.2.2 Automatic Lighting Shutoff.

Section 505.2.2.2 is amended to read:

505.2.2.2 Automatic lighting shutoff. Single-occupancy buildings or single-tenant spaces larger than 5,000 square feet (465 m^2) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:

1. A scheduled basis, using time-of-day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m²) and are not more than one floor; or
2. An occupant sensor that shall turn off the lighting within 30 minutes of an occupant leaving a space; or
3. A signal from another control or alarm system that indicates the area is unoccupied.

Exception: The following shall not require an automatic control device:

1. Sleeping units (see Section 505.2.3)
2. Lighting in spaces where patient care is directly provided.
3. Spaces where automatic shutoff would endanger occupant safety or security.
4. Buildings where the nature of the business activity operates 24 hours per day, as approved by the Building Official.

505.5.1 Total Connected Interior Lighting Power.

Section 505.5.1 is amended to read:

505.5.1 Total connected interior lighting power. The total connected interior lighting power (watts) shall be the sum of the watts of all interior lighting equipment as determined in accordance with Section 505.5.1.1 through 505.1.1.4.

Exceptions: The connected power associated with the following lighting equipment is not included in the calculating total connected lighting power.

1. Specialized medical, dental, and research lighting.
2. Professional and/or competition level sports playing area lighting.
3. Display lighting for exhibits in galleries, museums, monuments, and convention centers.
4. Sleeping unit lighting in hotels, motels, boarding houses or similar buildings.
5. Emergency lighting automatically off during normal building operation.
6. Casino Resort -- Front of House areas on properties classified as such by local jurisdictions.
7. Theatrical and special effects lighting.

8. Lighting for film, video or photography beyond general studio illumination.
9. Light Emitting Diode (LED) lighting sources.
10. Neon and cold cathode lighting sources.
11. Interior signage.
12. In a redundant, interlocked lighting system or in a system programmed to prevent simultaneous operation of more than one lighting system, the system using the least amount of power.
13. Lighting equipment available for purchase in a retail setting.
14. Task lighting.
15. Where specific lighting levels are required by state or local governmental criteria, the state or local code shall prevail. The total square footage of the area addressed in such codes shall be subtracted from the overall square footage of the space when utilized for energy calculations.
16. Display kitchen and bar areas.
17. Lighting that is integral to equipment or instrumentation and is installed by its manufacturer.

505.5.1.4 Line Voltage Lighting Track and Plug-In Busway.

Section 505.5.1.4 is amended to read:

Section 505.5.1.4 Line-voltage lighting track and plug-in busway. The wattage shall be the greater of the wattage of the luminaires determined in accordance with Sections 505.5.1.1 through 505.5.1.3 or 30 W/linear foot (98W/lin m). In track lighting equipped with a current limiting device, the wattage shall be the maximum rated power of the current limiting device.

Table 505.5.2 INTERIOR LIGHTING POWER ALLOWANCES.

Table 505.5.2 is deleted in its entirety and replaced with the following:

**TABLE 505.5.2
INTERIOR LIGHTING POWER ALLOWANCES**

LIGHTING POWER DENSITY	
Building Area Type ^a	(W/ft²)
Auditorium	1.8
Automotive Facility	0.9
Bank/Financial Institution ^c	1.5
Classroom/Lecture Hall	1.4
Convention Center ^c	1.3
Corridor, restroom, support area	0.9
Court House ^c	1.2
Dormitory	1.0
Exercise Center	1.0
Exhibit Hall	1.3
Grocery Store	1.6
Gymnasium Playing Surface	1.4
Healthcare-Clinic	1.0
Healthcare-Spa ^c	1.6
Hospital ^c	1.2
Hotel ^{b,c}	1.3
Industrial work	1.2
Kitchen	1.2
Library ^c	1.7
Lobby-hotel ^c	1.1
Lobby-other ^c	1.3
Mall, arcade, or atrium ^c	0.6
Motel	1.0
Motion Picture Theater ^{b,c}	1.2
Multi-Family	0.7
Museum ^c	1.1
Office ^c	1.1
Parking Garage	0.4
Penitentiary	1.0
Police/Fire Station	1.0
Post Office	1.1
Religious Worship ^{b,c}	2.4
Restaurant ^{b,c}	1.6
Retail Sales, wholesales, show room ^{b,c}	1.7
School/University	1.2
Sports Arena ^c	1.1
Storage, Industrial and Commercial	0.8
Theatre – Motion Picture	1.2
Theatre – Performance ^c	2.6

Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4
Other	1.0

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

- a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.
- b. Where lighting equipment is specified to be installed to highlight specific merchandise or displays in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits separate from the circuits for general lighting, the smaller of the actual wattage for the lighting equipment installed specifically for merchandise, or 21 W/ft times the length of the wall display, 1.6 W/ft² times the area of the specific display of the floor display, or 3.9 W/ft² times the actual case or shelf area for displaying and selling jewelry, china or silver, shall be added to the interior lighting power determined in accordance with this line item.
- c. Where lighting equipment is specified to be installed for decorative purposes in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits separate from the circuits for general lighting, the smaller of the actual wattage of the decorative lighting equipment or 1.5 W/ft² times the area of the space that the decorative lighting equipment is in shall be added to the interior lighting power determined in accordance with this line item.

505.5.2 Interior Lighting Power.

Section 505.5.2 is amended, and a new Table 505.5.3 is added, to read as follows:

505.5.2 Interior lighting power. The total interior lighting power (watts) is the sum of all interior lighting powers for all areas in the building covered in this permit. The interior lighting power is the floor area for each building area type listed in Table 505.5.2 times the value from Table 505.5.2 for that area. For areas with high ceilings and lighting fixture mounting heights that exceed 12 feet, an adjustment factor is allowed by multiplying the LPD value from Table 505.5.2 with the adjustment factor in Table 505.5.3. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type as listed in Table 505.5.2. When this method is used to calculate the total interior lighting power for an entire building, each building area type shall be treated as a separate area.

**TABLE 505.5.3
ADJUSTMENTS FOR MOUNTING HEIGHTS ABOVE FLOOR**

Height (in feet) above the finished floor to the bottom of luminaire(s)	Multiply LPD by
12 or less	1.0
13	1.05
14	1.10
15	1.15
16	1.21
17	1.47
18	1.65
19	1.84
20 or more	2.04

505.6 Exterior Lighting. (Mandatory).

Revise section 505.6 to read as follows:

505.6 Exterior lighting. (Mandatory). When the power for the exterior lighting is supplied through the energy service to the building, all exterior lighting, other than low-voltage lighting shall have a source efficacy of at least 45 lumens per Watt. Fixtures employing lamps rated over 100 Watts shall either have a source efficacy of at least 60 lumens per Watt or be controlled by a motion sensor.

Exceptions:

1. Where approved because of historical, safety, signage or emergency considerations.
2. Light Emitting Diode (LED), neon, and cold cathode exterior lamp sources.
3. Casino Resort--Front of House areas on properties classified by the local jurisdiction as casino resorts.
4. Where specific lighting levels are required by state or local governmental criteria, the state or local code shall prevail. Areas affected by this exemption include, but are not limited to, ATM's and parking garage emergency lighting.
5. Theatrical and special effects lighting.

Delete sections 505.6.1 and 505.6.2

505.7 Electrical Energy Consumption. (Mandatory)

Section 505.7 is amended by adding an exception, so that the section reads as follows:

505.7 Electrical energy consumption. (Mandatory). In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

Exception: Dwelling units with a transient occupancy such as timeshares.

AFFP DISTRICT COURT
Clark County, Nevada

AFFIDAVIT OF PUBLICATION

STATE OF NEVADA)
COUNTY OF CLARK) SS:

Donna Stark, being 1st duly sworn, deposes and says: That she is the Legal Clerk for the Las Vegas Review-Journal and the Las Vegas Sun, daily newspapers regularly issued, published and circulated in the City of Las Vegas, County of Clark, State of Nevada, and that the advertisement, a true copy attached for,

LV CITY CLERK 2296311LV 1373910

was continuously published in said Las Vegas Review-Journal and / or Las Vegas Sun in 1 edition(s) of said newspaper issued from 01/20/2007 to 01/20/2007, on the following days:

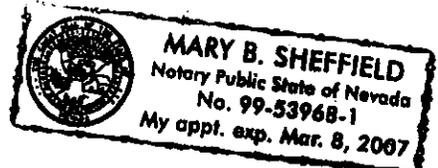
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01/20/2007
2007 FEB -5 P 2:18

BILL NO. 2006-76
ORDINANCE NO. 5882
AN ORDINANCE TO ADOPT THE 2006 EDITION OF THE INTERNATIONAL ENERGY CONSERVATION CODE, ALONG WITH AMENDMENTS THERETO, AND TO PROVIDE FOR OTHER RELATED MATTERS.
Proposed by: Paul K. Wilkins, Director of Building and Safety
Summary: Adopts the 2006 Edition of the International Energy Conservation Code, along with amendments thereto.
The above and foregoing ordinance was first proposed and read by title to the City Council on the 20th day of December 2006, and referred to a committee for recommendation; thereafter the committee reported favorably on said ordinance on the 17th day of January 2007, which was a regular meeting of said City Council; and that at said regular meeting the proposed ordinance was read by title to the City Council as first introduced and was adopted by the following vote:
VOTING "AYE": Mayor Goodman and Councilmembers Reese, Brown, Weekly, Wolfson, Tarkanian, and Ross
VOTING "NAY": NONE
EXCUSED: NONE
COPIES OF THE COMPLETE ORDINANCE ARE AVAILABLE FOR PUBLIC INFORMATION IN THE OFFICE OF THE CITY CLERK, 1ST FLOOR, 400 STEWART AVENUE, LAS VEGAS, NEVADA.
PUB: January 20, 2007
LV Review-Journal

Signed: Donna Stark

SUBSCRIBED AND SWORN BEFORE ME THIS, THE
24 day of January, 2007.

Mary B. Sheffield
Notary Public



2006 International Energy Conservation Code®

First Printing: January 2006

Second Printing: May 2006

ISBN-13: 978-1-58001-270-6 (soft)

ISBN-10: 1-58001-270-1 (soft)

ISBN-13: 978-1-58001-267-6 (loose-leaf)

ISBN-10: 1-58001-267-1 (loose-leaf)

ISBN-13: 978-1-58001-315-4 (e-document)

ISBN-10: 1-58001-315-5 (e-document)

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PRINTED IN THE U.S.A.

PREFACE

Introduction

Internationally, code officials recognize the need for a modern, up-to-date energy conservation code addressing the design of energy-efficient building envelopes and installation of energy efficient mechanical, lighting and power systems through requirements emphasizing performance. The *International Energy Conservation Code*[®], in this 2006 edition, is designed to meet these needs through model code regulations that will result in the optimal utilization of fossil fuel and nondepletable resources in all communities, large and small.

This comprehensive energy conservation code establishes minimum regulations for energy efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy efficient designs. This 2006 edition is fully compatible with all the *International Codes*[®] (I-Codes[®]) published by the International Code Council (ICC)[®], including: the *International Building Code*[®], *ICC Electrical Code*[®], *International Existing Building Code*[®], *International Fire Code*[®], *International Fuel Gas Code*[®], *International Mechanical Code*[®], *ICC Performance Code*[®], *International Plumbing Code*[®], *International Private Sewage Disposal Code*[®], *International Property Maintenance Code*[®], *International Residential Code*[®], *International Wildland-Urban Interface Code*[™] and *International Zoning Code*[®].

The *International Energy Conservation Code* provisions provide many benefits, among which is the model code development process that offers an international forum for energy professionals to discuss performance and prescriptive code requirements. This forum provides an excellent arena to debate proposed revisions. This model code also encourages international consistency in the application of provisions.

Development

The first edition of the *International Energy Conservation Code* (1998) was based on the 1995 edition of the *Model Energy Code* promulgated by the Council of American Building Officials (CABO) and included changes approved through the CABO Code Development Procedures through 1997. CABO assigned all rights and responsibilities to the International Code Council and its three statutory members at that time, including Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO) and Southern Building Code Congress International (SBCCI). This 2006 edition presents the code as originally issued, with changes reflected in the 2003 edition and further changes approved through the ICC Code Development Process through 2005. A new edition such as this is promulgated every three years.

This code is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Adoption

The *International Energy Conservation Code* is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference in accordance with proceedings establishing the jurisdiction's laws. At the time of adoption, jurisdictions should insert the appropriate information in provisions requiring specific local information, such as the name of the adopting jurisdiction. These locations are shown in bracketed words in small capital letters in the code and in the sample ordinance. The sample adoption ordinance on page v addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

Maintenance

The *International Energy Conservation Code* is kept up to date through the review of proposed changes submitted by code enforcing officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an open code development process in which all interested and affected parties may participate.

The contents of this work are subject to change both through the Code Development Cycles and the governmental body that enacts the code into law. For more information regarding the code development process, contact the Code and Standard Development Department of the International Code Council.

While the development procedure of the *International Energy Conservation Code* assures the highest degree of care, ICC, its members and those participating in the development of this code do not accept any liability resulting from compliance or noncompliance with the provisions because ICC and its members do not have the power or authority to police or enforce compliance with the contents of this code. Only the governmental body that enacts the code into law has such authority.

Letter Designations in Front of Section Numbers

In each code development cycle, proposed changes to this code are considered at the Code Development Hearing by the International Energy Conservation Code Development Committee, whose action constitutes a recommendation to the voting membership for final action on the proposed change. Proposed changes to a code section whose number begins with a letter in brackets are considered by a different code development committee. For instance, proposed changes to code sections which have the letter [EB] in front (e.g., [EB] 101.2.2.1), are considered by the International Existing Building Code Development Committee at the Code Development Hearing. Where this designation is applicable to the entire content of a main section of the code, the designation appears at the main section number and title and is not repeated at every subsection in that section.

The content of sections in this code which begin with a letter designation is maintained by another code development committee in accordance with the following:

- [B] = International Building Code Development Committee;
- [EB] = International Existing Building Code Development Committee; and
- [M] = International Mechanical Code Development Committee.

Marginal Markings

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2003 edition. Deletion indicators in the form of an arrow (→) are provided in the margin where an entire section, paragraph, exception or table has been deleted or an item in a list of items or a table has been deleted.

ORDINANCE

The International Codes are designed and promulgated to be adopted by reference by ordinance. Jurisdictions wishing to adopt the 2006 *International Energy Conservation Code* as an enforceable regulation governing energy efficient building envelopes and installation of energy efficient mechanical, lighting and power systems should ensure that certain factual information is included in the adopting ordinance at the time adoption is being considered by the appropriate governmental body. The following sample adoption ordinance addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

SAMPLE ORDINANCE FOR ADOPTION OF THE *INTERNATIONAL ENERGY CONSERVATION CODE* ORDINANCE NO. _____

An ordinance of the [JURISDICTION] adopting the 2006 edition of the *International Energy Conservation Code*, regulating and governing energy efficient building envelopes and installation of energy efficient mechanical, lighting and power systems in the [JURISDICTION]; providing for the issuance of permits and collection of fees therefor; repealing Ordinance No. _____ of the [JURISDICTION] and all other ordinances and parts of the ordinances in conflict therewith.

The [GOVERNING BODY] of the [JURISDICTION] does ordain as follows:

Section 1. That a certain document, three (3) copies of which are on file in the office of the [TITLE OF JURISDICTION'S KEEPER OF RECORDS] of [NAME OF JURISDICTION], being marked and designated as the *International Energy Conservation Code*, 2006 edition, as published by the International Code Council, be and is hereby adopted as the Energy Conservation Code of the [JURISDICTION], in the State of [STATE NAME] for regulating and governing energy efficient building envelopes and installation of energy efficient mechanical, lighting and power systems as herēin provided; providing for the issuance of permits and collection of fees therefor; and each and all of the regulations, provisions, penalties, conditions and terms of said Energy Conservation Code on file in the office of the [JURISDICTION] are hereby referred to, adopted, and made a part hereof, as if fully set out in this ordinance, with the additions, insertions, deletions and changes, if any, prescribed in Section 2 of this ordinance.

Section 2. The following sections are hereby revised:

Section 101.1. Insert: [NAME OF JURISDICTION].

Section 3. That Ordinance No. _____ of [JURISDICTION] entitled [FILL IN HERE THE COMPLETE TITLE OF THE ORDINANCE OR ORDINANCES IN EFFECT AT THE PRESENT TIME SO THAT THEY WILL BE REPEALED BY DEFINITE MENTION] and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

Section 4. That if any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance. The [GOVERNING BODY] hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

Section 5. That nothing in this ordinance or in the Energy Conservation Code hereby adopted shall be construed to affect any suit or proceeding impending in any court, or any rights acquired, or liability incurred, or any cause or causes of action acquired or existing, under any act or ordinance hereby repealed as cited in Section 3 of this ordinance; nor shall any just or legal right or remedy of any character be lost, impaired or affected by this ordinance.

Section 6. That the [JURISDICTION'S KEEPER OF RECORDS] is hereby ordered and directed to cause this ordinance to be published. (An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation. Posting may also be required.)

Section 7. That this ordinance and the rules, regulations, provisions, requirements, orders and matters established and adopted hereby shall take effect and be in full force and effect [TIME PERIOD] from and after the date of its final passage and adoption.

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CHAPTER 1

ADMINISTRATION

This chapter has been revised in its entirety; there will be no marginal markings.

SECTION 101

SCOPE AND GENERAL REQUIREMENTS

101.1 Title. This code shall be known as the *International Energy Conservation Code* of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as "this code."

101.2 Scope. This code applies to residential and commercial buildings.

101.3 Intent. This code shall regulate the design and construction of buildings for the effective use of energy. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

101.4 Applicability.

101.4.1 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

101.4.2 Historic buildings. Any building or structure that is listed in the State or National Register of Historic Places; designated as a historic property under local or state designation law or survey; certified as a contributing resource with a National Register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the National or State Registers of Historic Places either individually or as a contributing building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, are exempt from this code.

101.4.3 Additions, alterations, renovations or repairs. Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations, or repairs shall not create an unsafe or hazardous condition or overload existing building systems.

Exception: The following need not comply provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Glass only replacements in an existing sash and frame.
3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.

4. Construction where the existing roof, wall or floor cavity is not exposed.

101.4.4 Change in occupancy. Buildings undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

101.4.5 Mixed occupancy. Where a building includes both residential and commercial occupancies, each occupancy shall be separately considered and meet the applicable provisions of Chapter 4 for residential and Chapter 5 for commercial.

101.5 Compliance. Residential buildings shall meet the provisions of Chapter 4. Commercial buildings shall meet the provisions of Chapter 5.

101.5.1 Compliance materials. The code official shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

101.5.2 Low energy buildings. The following buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this code shall be exempt from the building thermal envelope provisions of this code:

1. Those with a peak design rate of energy usage less than 3.4 Btu/h-ft² (10.7 W/m²) or 1.0 watt/ft² (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.

SECTION 102

MATERIALS, SYSTEMS AND EQUIPMENT

102.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

102.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

102.1.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed R-value shall be listed on certification provided by the insulation installer.

102.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's R-value mark is readily observable upon inspection.

102.1.3 Fenestration product rating. U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled U-factor shall be assigned a default U-factor from Table 102.1.3(1) or 102.1.3(2). The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC shall be assigned a default SHGC from Table 102.1.3(3).

**TABLE 102.1.3(1)
DEFAULT GLAZED FENESTRATION U-FACTOR**

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

**TABLE 102.1.3(2)
DEFAULT DOOR U-FACTORS**

DOOR TYPE	U-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

**TABLE 102.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC**

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

102.2 Installation. All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the *International Building Code*.

102.2.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawl-space walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (153 mm) below grade.

102.3 Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

**SECTION 103
ALTERNATE MATERIALS—METHOD
OF CONSTRUCTION, DESIGN
OR INSULATING SYSTEMS**

103.1 General. This code is not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the code official as meeting the intent of this code.

103.1.1 Above code programs. The code official or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy efficiency program shall be considered in compliance with this code.

**SECTION 104
CONSTRUCTION DOCUMENTS**

104.1 General. Construction documents and other supporting data shall be submitted in one or more sets with each application for a permit. The code official is authorized to require necessary construction documents to be prepared by a registered design professional.

Exception: The code official is authorized to waive the requirements for construction documents or other supporting data if the code official determines they are not necessary to confirm compliance with this code.

104.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, insulation materials and their R-values; fenestration U-factors and SHGCs; system and equipment efficiencies, types, sizes

and controls; duct sealing, insulation and location; and air sealing details.

SECTION 105 INSPECTIONS

105.1 General. Construction or work for which a permit is required shall be subject to inspection by the code official.

105.2 Required approvals. No work shall be done on any part of the building beyond the point indicated in each successive inspection without first obtaining the written approval of the code official. No construction shall be concealed without being inspected and approved.

105.3 Final inspection. The building shall have a final inspection and not be occupied until approved.

105.4 Reinspection. A building shall be reinspected when determined necessary by the code official.

SECTION 106 VALIDITY

106.1 General. If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

SECTION 107 REFERENCED STANDARDS

107.1 General. The standards, and portions thereof, referred to in this code and listed in Chapter 6 shall be considered part of the requirements of this code to the extent of such reference.

107.2 Conflicting requirements. Where the provisions of this code and the referenced standards conflict, the provisions of this code shall take precedence.

CHAPTER 2

DEFINITIONS

This chapter has been revised in its entirety; there will be no marginal markings.

SECTION 201 GENERAL

201.1 Scope. Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

201.2 Interchangeability. Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

201.3 Terms defined in other codes. Terms that are not defined in this code but are defined in the *International Building Code, ICC Electrical Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, or the International Residential Code* shall have the meanings ascribed to them in those codes.

201.4 Terms not defined. Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

SECTION 202 GENERAL DEFINITIONS

ABOVE GRADE WALL. A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof, and skylight shafts.

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see "Readily accessible").

ADDITION. An extension or increase in the conditioned space floor area or height of a building or structure.

ALTERATION. Any construction or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

APPROVED. Approval by the code official as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

BASEMENT WALL. A wall 50 percent or more below grade and enclosing conditioned space.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space.

CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential buildings."

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the conditioned space.

CONDITIONED SPACE. An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent conditioned space.

CRAWL SPACE WALL. The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

ECONOMIZER, AIR. A duct and damper arrangement and automatic control system that allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

ECONOMIZER, WATER. A system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

ENERGY ANALYSIS. A method for estimating the annual energy use of the proposed design and standard reference design based on estimates of energy use.

ENERGY COST. The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

ENERGY RECOVERY VENTILATION SYSTEM. Systems that employ air-to-air heat exchangers to recover energy

DEFINITIONS

from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

ENERGY SIMULATION TOOL. An approved software program or calculation-based methodology that projects the annual energy use of a building.

ENTRANCE DOOR. Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware, automatic closers and contain over 50 percent glass specifically designed to withstand heavy use and possibly abuse.

EXTERIOR WALL. Walls including both above grade walls and basement walls.

FENESTRATION. Skylights, roof windows, vertical windows (fixed or moveable), opaque doors, glazed doors, glazed block, and combination opaque/glazed doors. Fenestration includes products with glass and non-glass glazing materials.

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosiphoning of hot water during standby periods.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under the slab.

HUMIDISTAT. A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

INFILTRATION. The uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

INSULATING SHEATHING. An insulating board with a core material having a minimum *R*-value of R-2.

LABELED. Devices, equipment, or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items that attests to compliance with a specific standard.

LISTED. Equipment, appliances, assemblies or materials included in a list published by an approved testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment, appliances, assemblies or material, and whose listing states either that the equipment, appliances, assemblies, or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

LOW-VOLTAGE LIGHTING. Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

MANUAL. Capable of being operated by personal intervention (see "Automatic").

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible").

REPAIR. The reconstruction or renewal of any part of an existing building.

RESIDENTIAL BUILDING. For this code, includes R-3 buildings, as well as R-2 and R-4 buildings three stories or less in height above grade.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$) [$(\text{m}^2 \cdot \text{K})/\text{W}$].

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment, roof deck, insulation, vapor retarder and interior finish.

SCREW LAMP HOLDERS. A lamp base that requires a screw-in-type lamp, such as a compact-fluorescent, incandescent, or tungsten-halogen bulb.

SERVICE WATER HEATING. Supply of hot water for purposes other than comfort heating.

SKYLIGHT. Glass or other transparent or translucent glazing material installed at a slope of 15 degrees (0.26 rad) or more from vertical. Glazing material in skylights, including unit skylights, solariums, sunrooms, roofs and sloped walls is included in this definition.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

STOREFRONT. A nonresidential system of doors and windows mullied as a composite fenestration structure that has been designed to resist heavy use and possible abuse and provide a high level of resistance to wind load and impact from wind borne debris. Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.

SUNROOM. A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

THERMAL ISOLATION. Physical and space conditioning separation from conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

U-FACTOR (THERMAL TRANSMITTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h · ft² · °F) [W/(m² · K)].

VAPOR RETARDER. A vapor resistant material, membrane or covering such as foil, plastic sheeting, or insulation facing having a permeance rating of 1 perm (5.7×10^{-11} kg/Pa · s · m²) or less when tested in accordance with the desiccant method using Procedure A of ASTM E 96. Vapor retarders limit the amount of moisture vapor that passes through a material or wall assembly.

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

ZONE. A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

CHAPTER 3

CLIMATE ZONES

This chapter has been revised in its entirety; there will be no marginal markings.

SECTION 301

CLIMATE ZONES

301.1 General. Climate zones from Figure 301.1 or Table 301.1 shall be used in determining the applicable requirements from Chapters 4 and 5. Locations not in Table 301.1 (outside the US) shall be assigned a climate zone based on Section 301.3.

301.2 Warm humid counties. Warm humid counties are listed in Table 301.2.

301.3 International climate zones. The climate zone for any location outside the United States shall be determined by applying Table 301.3(1) and then Table 301.3(2).

301.3.1 Warm humid criteria. "Warm humid" locations shall be defined as locations where either of the following conditions occurs:

1. 67°F (19.4°C) or higher wet-bulb temperature for 3,000 or more hours during the warmest six consecutive months of the year;
2. 73°F (22.8°C) or higher wet-bulb temperature for 1,500 or more hours during the warmest six consecutive months of the year.

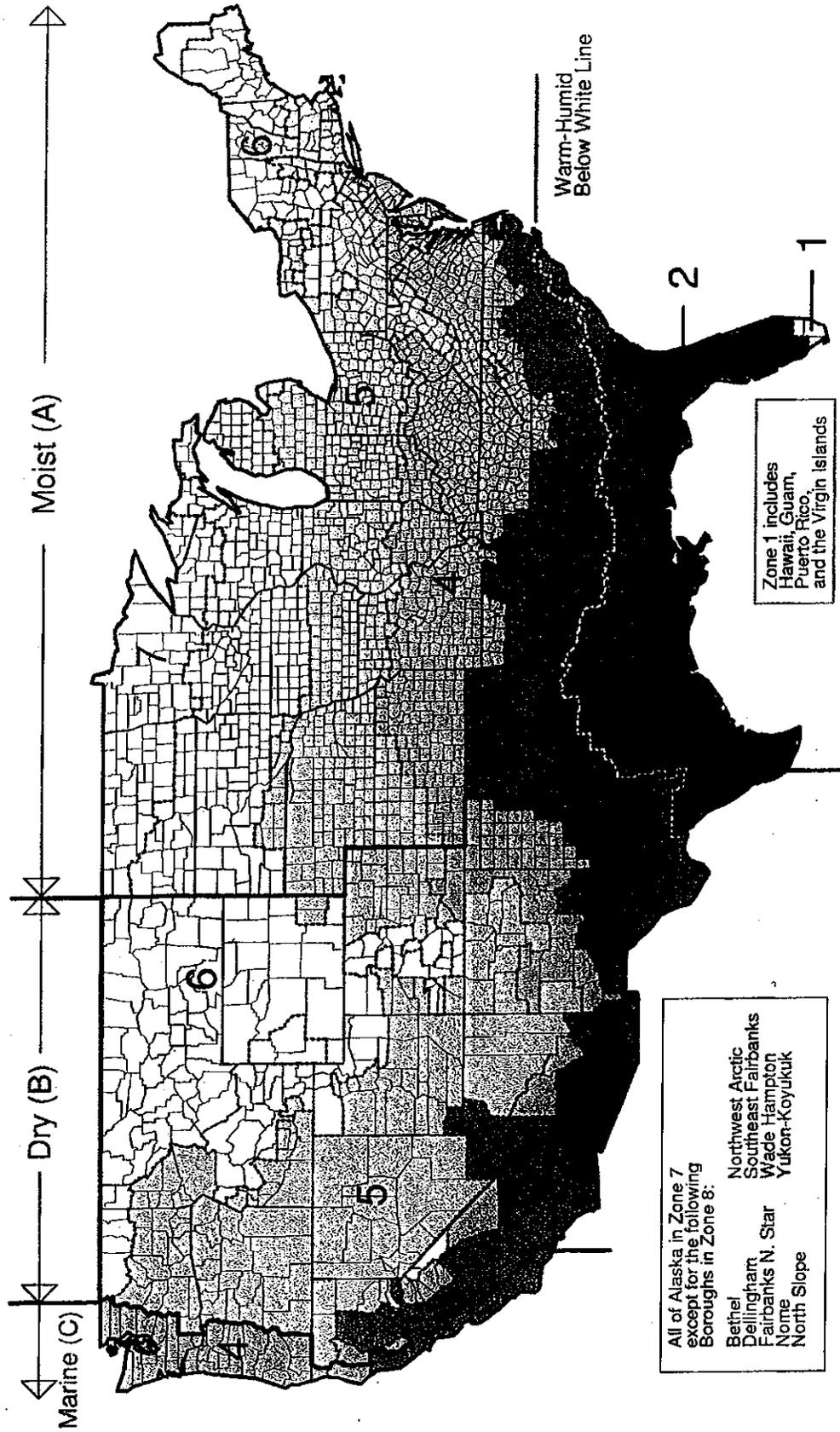


FIGURE 301.1
CLIMATE ZONES

TABLE 301.1
CLIMATE ZONES BY STATE, COUNTY AND TERRITORIES

ALABAMA	Zone 3 Dry except	Dolores	Colquitt	Canyon
Zone 3 except	Zone 2	Eagle	Cook	Cassia
Zone 2	Imperial	Moffat	Decatur	Clearwater
Baldwin	Zone 3 Marine	Ouray	Echols	Elmore
Mobile	Alameda	Rio Blanco	Effingham	Gem
	Marin	Saguache	Evans	Gooding
	Mendocino	San Miguel	Glynn	Idaho
ALASKA	Monterey	Zone 7	Grady	Jerome
Zone 7 except	Napa	Clear Creek	Jeff Davis	Kootenai
Zone 8	San Benito	Grand	Lanier	Latah
Bethel	San Francisco	Gunnison	Liberty	Lewis
Dellingham	San Luis Obispo	Hinsdale	Long	Lincoln
Fairbanks	San Mateo	Jackson	Lowndes	Minidoka
Nome	Santa Barbara	Lake	McIntosh	Nez Perce
North Slope	Santa Clara	Mineral	Miller	Owyhee
North Star	Santa Cruz	Park	Mitchell	Payette
Northwest Arctic	Sonoma	Pitkin	Pierce	Power
Southeast Fairbanks	Ventura	Rio Grande	Seminole	Shoshone
Wade Hampton	Zone 4 Dry	Routt	Tattnall	Twin Falls
Yukon-Koyukuk	Amador	San Juan	Thomas	Washington
	Calaveras	Summit	Toombs	
	El Dorado		Ware	ILLINOIS
ARIZONA	Inyo	CONNECTICUT	Wayne	Zone 5 except
Zone 3 except	Lake	Zone 5	Zone 4	Zone 4
Zone 2	Mariposa	Delaware	Banks	Alexander
La Paz	Trinity	Zone 4	Catoosa	Bond
Maricopa	Tuolumne		Chattooga	Christian
Pima	Zone 4 Marine	DIST OF	Dade	Clay
Pinal	Del Norte	COLUMBIA	Dawson	Clinton
Yuma	Humboldt	Zone 4	Fannin	Crawford
Zone 4	Zone 5		Floyd	Edwards
Gila	Lassen	FLORIDA	Franklin	Effingham
Yavapai	Modoc	Zone 2 except	Gilmer	Fayette
Zone 5	Nevada	Zone 1	Gordon	Franklin
Apache	Plumas	Broward	Habersham	Gallatin
Coconino	Sierra	Dade	Hall	Hamilton
Navajo	Siskiyou	Monroe	Lumpkin	Hardin
	Zone 6		Murray	Jackson
ARKANSAS	Alpine	GEORGIA	Pickens	Jasper
Zone 3 except	Mono	Zone 3 except	Rabun	Jefferson
Zone 4	COLORADO	Zone 2	Stephens	Johnson
Baxter	Zone 5 except	Appling	Towns	Lawrence
Benton	Zone 4	Atkinson	Union	Macoupin
Boone	Baca	Bacon	Walker	Madison
Carroll	Las Animas	Baker	White	Marion
Fulton	Otero	Berrien	Whitfield	Massac
Izard	Zone 6	Brantley		Monroe
Madison	Alamosa	Brooks	HAWAII	Montgomery
Marion	Archuleta	Bryan	Zone 1 Molst	Perry
Newton	Chaffee	Camden		Pope
Searcy	Conejos	Charlton	IDAHO	Pulaski
Stone	Costilla	Chatham	Zone 6 except	Randolph
Washington	Custer	Clinch	Zone 5	Richland
CALIFORNIA			Ada	Saline
			Benewah	Shelby

(continued)

CLIMATE ZONES

**TABLE 301.1—continued
CLIMATE ZONES BY STATE, COUNTY AND TERRITORIES**

St Clair	Clay	Sherman	MICHIGAN	Zone 7
Union	Clayton	Smith	Zone 5 except	Aitkin
Wabash	Delaware	Thomas	Zone 6	Becker
Washington	Dickinson	Trego	Alcona	Beltrami
Wayne	Emmet	Wallace	Alger	Carlton
White	Fayette	Wichita	Alpena	Cass
Williamson	Floyd		Antrim	Clay
	Franklin		Arenac	Clearwater
INDIANA	Grundy	KENTUCKY	Benzie	Cook
Zone 5 except	Hamilton	Zone 4	Charlevoix	Crow Wing
Zone 4	Hancock		Cheboygan	Grant
Brown	Hardin	LOUISIANA	Clare	Hubbard
Clark	Howard	Zone 2 except	Crawford	Itasca
Crawford	Humboldt	Zone 3	Delta	Kanabec
Daviess	Ida	Bienville	Dickinson	Kittson
Dearborn	Kossuth	Bossier	Emmet	Koochiching
Dubois	Lyon	Caddo	Gladwin	Lake Of The Woods
Floyd	Mitchell	Caldwell	Grand Traverse	Mahnomen
Gibson	O'Brien	Catahoula	Huron	Marshall
Greene	Osceola	Claiborne	Iosco	Mille Lacs
Harrison	Palo Alto	Concordia	Isabella	Norman
Jackson	Plymouth	De Soto	Kalkaska	Otter Tail
Jefferson	Pocahontas	East Carroll	Lake	Pennington
Jennings	Sac	Franklin	Leelanau	Pine
Knox	Sioux	Grant	Manistee	Polk
Lawrence	Webster	Jackson	Marquette	Red Lake
Martin	Winnebago	La Salle	Mason	Roseau
Monroe	Winneshiek	Lincoln	Mecosta	St Louis
Ohio	Worth	Madison	Menominee	Wadena
Orange	Wright	Morehouse	Missaukee	Wilkin
Perry		Natchitoches	Montmorency	
Pike	KANSAS	Ouachita	Newaygo	MISSISSIPPI
Posey	Zone 4 except	Red River	Oceana	Zone 3 except
Ripley	Zone 5	Richland	Ogemaw	Zone 2
Scott	Cheyenne	Sabine	Osceola	Hancock
Spencer	Cloud	Tensas	Oscoda	Harrison
Sullivan	Decatur	Union	Otsego	Jackson
Switzerland	Ellis	Vernon	Presque Isle	Pearl River
Vanderburgh	Gove	Webster	Roscommon	Stone
Warrick	Graham	West Carroll	Sanilac	
Washington	Greeley	Winn	Wexford	MISSOURI
	Hamilton		Zone 7	Zone 4 except
IOWA	Jewell	MAINE	Baraga	Zone 5
Zone 5 except	Lane	Zone 6 except	Chippewa	Adair
Zone 6	Logan	Zone 7	Gogebic	Andrew
Allamakee	Mitchell	Aroostook	Houghton	Atchison
Black Hawk	Ness		Iron	Buchanan
Bremer	Norton	MARYLAND	Keweenaw	Caldwell
Buchanan	Osborne	Zone 4 except	Luce	Chariton
Buena Vista	Phillips	Zone 5	Mackinac	Clark
Butler	Rawlins	Garrett	Ontonagon	Clinton
Calhoun	Republic		Schoolcraft	Daviess
Cerro Gordo	Rooks	MASSACHUSETTS		De Kalb
Cherokee	Scott	Zone 5	MINNESOTA	Gentry
Chickasaw	Sheridan		Zone 6 except	Grundy

(continued)

TABLE 301.1—continued
CLIMATE ZONES BY STATE, COUNTY AND TERRITORIES

Harrison	Zone 3	Sullivan	Wilkes	Cimarron
Holt	Chaves	Tompkins	Yadkin	Texas
Knox	Dona Ana	Ulster	Zone 5	OREGON
Lewis	Eddy	Warren	Alleghany	Zone 4 Marine except
Linn	Hidalgo	Wyoming	Ashe	Zone 5 Dry
Livingston	Lea	NORTH CAROLINA	Avery	Baker
Macon	Luna	Zone 3 except	Mitchell	Crook
Marion	Otero	Zone 4	Watauga	Deschutes
Mercer	Zone 5	Alamance	Yancey	Gilliam
Nodaway	Catron	Alexander	NORTH DAKOTA	Grant
Pike	Colfax	Bertie	Zone 7 except	Harney
Putnam	Harding	Buncombe	Zone 6	Hood River
Ralls	Los Alamos	Burke	Adams	Jefferson
Schuyler	McKinley	Caldwell	Billings	Klamath
Scotland	Mora	Caswell	Bowman	Lake
Shelby	Rio Arriba	Catawba	Burleigh	Malheur
Sullivan	San Juan	Chatham	Dickey	Morrow
Worth	San Miguel	Cherokee	Dunn	Sherman
MONTANA	Sandoval	Clay	Emmons	Umatilla
Zone 6	Santa Fe	Cleveland	Golden Valley	Union
NEBRASKA	Taos	Davie	Grant	Wallowa
Zone 5	Torrance	Durham	Hettinger	Wasco
NEVADA	NEW YORK	Forsyth	La Moure	Wheeler
Zone 5 except	Zone 5 except	Franklin	Logan	PENNSYLVANIA
Zone 3	Zone 4	Gates	McIntosh	Zone 5 except
Clark	Bronx	Graham	McKenzie	Zone 4
NEW HAMPSHIRE	Kings	Granville	Mercer	Bucks
Zone 6 except	Nassau	Guilford	Morton	Chester
Zone 5	New York	Halifax	Oliver	Delaware
Cheshire	Queens	Harnett	Ransom	Montgomery
Hillsborough	Richmond	Haywood	Richland	Philadelphia
Rockingham	Suffolk	Henderson	Sargent	York
Strafford	Westchester	Hertford	Sioux	Zone 6
NEW JERSEY	Zone 6	Iredell	Slope	Cameron
Zone 4 except	Allegany	Jackson	Stark	Clearfield
Zone 5	Broome	Lee	OHIO	Eik
Bergen	Cattaraugus	Lincoln	Zone 5 except	McKean
Hunterdon	Chenango	Macon	Zone 4	Potter
Mercer	Clinton	Madison	Adams	Susquehanna
Morris	Delaware	McDowell	Brown	Tioga
Passaic	Essex	Nash	Clermont	Wayne
Somerset	Franklin	Northampton	Gallia	RHODE ISLAND
Sussex	Fulton	Orange	Hamilton	Zone 5
Warren	Hamilton	Person	Lawrence	SOUTH CAROLINA
NEW MEXICO	Herkimer	Polk	Pike	Zone 3
Zone 4 except	Jefferson	Rockingham	Scioto	SOUTH DAKOTA
	Lewis	Rutherford	Washington	Zone 6 except
	Madison	Stokes		Zone 5
	Montgomery	Surry		Bennett
	Oneida	Swain	OKLAHOMA	
	Otsego	Transylvania	Zone 3 Moist except	
	Schoharie	Vance	Zone 4 Dry	
	Schuyler	Wake	Beaver	
	St Lawrence	Warren		
	Steuben			

(continued)

CLIMATE ZONES

TABLE 301.1—continued
CLIMATE ZONES BY STATE, COUNTY AND TERRITORIES

Bon Homme	Coke	Terrell	Red River	Carbon
Charles Mix	Coleman	Terry	Rockwall	Daggett
Clay	Collingsworth	Throckmorton	Rusk	Duchesne
Douglas	Concho	Tom Green	Sabine	Morgan
Gregory	Cottle	Upton	San Augustine	Rich
Hutchinson	Crane	Ward	San Saba	Summit
Jackson	Crockett	Wheeler	Shelby	Uintah
Mellette	Crosby	Wilbarger	Smith	Wasatch
Todd	Culberson	Winkler	Somervell	
Tripp	Dawson	Zone 3 Moist	Stephens	VERMONT
Union	Dickens	Archer	Tarrant	Zone 6
Yankton	Ector	Blanco	Titus	
	El Paso	Bowie	Upshur	VIRGINIA
	Fisher	Brown	Van Zandt	Zone 4
	Foard	Burnet	Wichita	
TENNESSEE	Gaines	Camp	Wise	WASHINGTON
Zone 4 except	Garza	Cass	Wood	Zone 4 Marine except
Zone 3	Glasscock	Clay	Young	Zone 5 Dry
Chester	Hall	Collin	Zone 4	Adams
Crockett	Hardeman	Comanche	Armstrong	Asotin
Dyer	Haskell	Cooke	Bailey	Benton
Fayette	Hemphill	Dallas	Briscoe	Chelan
Hardeman	Howard	Delta	Carson	Columbia
Hardin	Howard	Denton	Castro	Douglas
Haywood	Hudspeth	Eastland	Cochran	Franklin
Henderson	Irion	Ellis	Dallam	Garfield
Lake	Jeff Davis	Erath	Deaf Smith	Grant
Lauderdale	Jones	Fannin	Donley	Kittitas
Madison	Kent	Franklin	Floyd	Klickitat
McNairy	Kerr	Gillespie	Gray	Lincoln
Shelby	Kimble	Grayson	Hale	Skamania
Tipton	King	Gregg	Hansford	Spokane
TEXAS	Knox	Hamilton	Hartley	Walla Walla
Zone 2 Moist except	Loving	Harrison	Hockley	Whitman
Zone 2 Dry	Lubbock	Henderson	Hutchinson	Yakima
Bandera	Lynn	Hood	Lamb	Zone 6 Dry
Dimmit	Martin	Hopkins	Lipscomb	Ferry
Edwards	Mason	Hunt	Moore	Okanogan
Frio	Mcculloch	Jack	Ochiltree	Pend Oreille
Kinney	Menard	Johnson	Oldham	Stevens
La Salle	Midland	Kaufman	Parmer	
Maverick	Mitchell	Kendall	Potter	WEST VIRGINIA
Medina	Motley	Lamar	Randall	Zone 5 except
Real	Nolan	Lampasas	Roberts	Zone 4
Uvalde	Pecos	Llano	Sherman	Zone 4
Val Verde	Presidio	Marion	Swisher	Berkeley
Webb	Reagan	Mills	Yoakum	Boone
Zapata	Reeves	Montague		Braxton
Zavala	Runnels	Morris	UTAH	Cabell
Zone 3 Dry	Schleicher	Nacogdoches	Zone 5 except	Calhoun
Andrews	Scurry	Navarro	Zone 3	Clay
Baylor	Shackelford	Palo Pinto	Washington	Gilmer
Borden	Sterling	Panola	Zone 6	Jackson
Brewster	Stonewall	Parker	Box Elder	Jefferson
Callahan	Sutton	Rains	Cache	Kanawha
Childress	Taylor			

(continued)

TABLE 301.1—continued
CLIMATE ZONES BY STATE, COUNTY AND TERRITORIES

Lincoln	Taylor
Logan	Vilas
Mason	Washburn
McDowell	WYOMING
Mercer	Zone 6 except
Mingo	Zone 5
Monroe	Goshen
Morgan	Platte
Pleasants	Zone 7
Putnam	Lincoln
Ritchie	Sublette
Roane	Teto
Tyler	
Wayne	
Wirt	TERRITORIES
Wood	AMERICAN
Wyoming	SAMOA
	Zone 1 Moist
WISCONSIN	
Zone 6 except	
Zone 7	GUAM
Ashland	Zone 1 Moist
Bayfield	
Burnett	NORTHERN
Douglas	MARIANAS
Florence	Zone 1 Moist
Forest	
Iron	PUERTO RICO
Langlade	Zone 1 Moist
Lincoln	
Oneida	U.S. VIRGIN
Price	ISLANDS
Sawyer	Zone 1 Moist

CLIMATE ZONES

TABLE 301.2
WARM HUMID COUNTIES AND TERRITORIES

ALABAMA	Candler	Claiborne	NORTH CAROLINA	Lamar
Autauga	Chattahoochee	Concordia	Brunswick	Lampasas
Baldwin	Clay	De Soto	Carteret	Llano
Barbour	Coffee	Franklin	Columbus	Marion
Bullock	Crisp	Grant	New Hanover	Mills
Butler	Dodge	Jackson	Onslow	Morris
Choctaw	Dooly	La Salle	Pender	Nacogdoches
Clarke	Dougherty	Lincoln		Navarro
Coffee	Early	Madison	SOUTH CAROLINA	Palo Pinto
Conecuh	Emanuel	Natchitoches	Allendale	Panola
Covington	Houston	Ouachita	Barnberg	Parker
Crenshaw	Irwin	Red River	Barnwell	Rains
Dale	Jenkins	Richland	Beaufort	Red River
Dallas	Johnson	Sabine	Berkeley	Rockwall
Elmore	Laurens	Tensas	Charleston	Rusk
Escambia	Lee	Union	Colleton	Sabine
Geneva	Macon	Vernon	Dorchester	San Augustine
Henry	Marion	Webster	Georgetown	San Saba
Houston	Montgomery	Winn	Hampton	Shelby
Lowndes	Peach		Horry	Smith
Macon	Pulaski	MISSISSIPPI	Jasper	Somervell
Marengo	Quitman	All in Zone 2 Plus		Tarrant
Mobile	Randolph	Adams	TEXAS	Titus
Monroe	Schley	Amite	All in Zone 2 Plus	Upshur
Montgomery	Screven	Claiborne	Blanco	Van Zandt
Perry	Stewart	Copiah	Bowie	Wood
Pike	Sumter	Covington	Brown	
Russell	Taylor	Forrest	Burnet	TERRITORIES
Washington	Telfair	Franklin	Camp	AMERICAN
Wilcox	Terrell	George	Cass	SAMOA
	Tift	Greene	Collin	All
ARKANSAS	Treutlen	Hinds	Comanche	
Columbia	Turner	Jefferson	Dallas	GUAM
Hempstead	Twiggs	Jefferson Davis	Delta	All
Lafayette	Webster	Jones	Denton	
Little River	Wheeler	Lamar	Ellis	NORTHERN
Miller	Wilcox	Lawrence	Erath	MARIANAS
Sevier	Worth	Lincoln	Franklin	All
Union		Marion	Gillespie	
	HAWAII	Perry	Gregg	PUERTO RICO
FLORIDA	All	Pike	Hamilton	All
All		Rankin	Harrison	
	LOUISIANA	Simpson	Henderson	
GEORGIA	All in Zone 2 Plus	Smith	Hood	U.S. VIRGIN
All in Zone 2 Plus	Bienville	Walthall	Hopkins	ISLANDS
Ben Hill	Bossier	Warren	Hunt	All
Bleckley	Caddo	Wayne	Johnson	
Bullock	Caldwell	Wilkinson	Kaufman	
Calhoun	Catahoula		Kendall	

TABLE 301.3(1)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

MAJOR CLIMATE TYPE DEFINITIONS
<p>Marine (C) Definition - Locations meeting all four criteria:</p> <ol style="list-style-type: none"> 1. Mean temperature of coldest month between -3°C (27°F) and 18°C (65°F) 2. Warmest month mean < 22°C (72°F) 3. At least four months with mean temperatures over 10°C (50°F) 4. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.
<p>Dry (B) Definition - Locations meeting the following criteria: Not Marine and</p> $P_{in} < 0.44 \times (TF - 19.5) - [P_{cm} < 2.0 \times (TC + 7) \text{ in SI units}]$ <p>where:</p> <p>P_{in} = Annual precipitation in inches (cm)</p> <p>T = Annual mean temperature in °F (°C)</p>
<p>Moist (A) Definition - Locations that are not Marine and not Dry.</p>

For SI: °C = [(°F)-32]/1.8; 1 inch = 2.54 cm.

TABLE 301.3(2)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
1	9000 < CDD50°F	5000 < CDD10°C
2	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3A and 3B	4500 < CDD50°F ≤ 6300 AND HDD65°F ≤ 5400	2500 < CDD10°C ≤ 3500 AND HDD18°C ≤ 3000
4A and 4B	CDD50°F ≤ 4500 AND HDD65°F ≤ 5400	CDD10°C ≤ 2500 AND HDD18°C ≤ 3000
3C	HDD65°F ≤ 3600	HDD18°C ≤ 2000
4C	3600 < HDD65°F ≤ 5400	2000 < HDD18°C ≤ 3000
5	5400 < HDD65°F ≤ 7200	3000 < HDD18°C ≤ 4000
6	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	12600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F)-32]/1.8

SECTION 302 DESIGN CONDITIONS

302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

CHAPTER 4

RESIDENTIAL ENERGY EFFICIENCY

This chapter has been revised in its entirety; there will be no marginal markings.

SECTION 401 GENERAL

401.1 Scope. This chapter applies to residential buildings.

401.2 Compliance. Projects shall comply with Sections 401, 402.4, 402.5, 402.6 and 403 (referred to as the mandatory provisions) and either:

1. Sections 402.1 through 402.3 (prescriptive); or
2. Section 404 (performance).

401.3 Certificate. A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration; and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.

SECTION 402 BUILDING THERMAL ENVELOPE

402.1 General. (Prescriptive).

402.1.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.

402.1.2 *R*-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films.

402.1.3 *U*-factor alternative. An assembly with a *U*-factor equal to or less than that specified in Table 402.1.3 shall be permitted as an alternative to the *R*-value in Table 402.1.1.

Exception: For mass walls not meeting the criterion for insulation location in Section 402.2.3, the *U*-factor shall be permitted to be:

1. *U*-factor of 0.17 in Climate Zone 1.
2. *U*-factor of 0.14 in Climate Zone 2.
3. *U*-factor of 0.12 in Climate Zone 3.

**TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT***

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT ^b <i>U</i> -FACTOR	GLAZED FENESTRATION SHGC	CEILING <i>R</i> -VALUE	WOOD FRAME WALL <i>R</i> -VALUE	MASS WALL <i>R</i> -VALUE	FLOOR <i>R</i> -VALUE	BASEMENT ^c WALL <i>R</i> -VALUE	SLAB ^d <i>R</i> -VALUE & DEPTH	CRAWL SPACE ^e WALL <i>R</i> -VALUE
1	1.20	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40 ^c	30	13	5	19	0	0	5 / 13
4 except Marine	0.40	0.60	NR	38	13	5	19	10 / 13	10, 2 ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	19 or 13+5 ^g	13	30 ^f	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	19 or 13+5 ^g	15	30 ^f	10 / 13	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19	30 ^f	10 / 13	10, 4 ft	10 / 13

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. *R*-19 shall be permitted to be compressed into a 2 × 6 cavity.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. The first *R*-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.

d. *R*-5 shall be added to the required slab edge *R*-values for heated slabs.

e. There are no SHGC requirements in the Marine zone.

f. Or insulation sufficient to fill the framing cavity, *R*-19 minimum.

g. "13+5" means *R*-13 cavity insulation plus *R*-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least *R*-2.

TABLE 402.1.3
EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	1.2	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.75	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.65	0.65	0.035	0.082	0.141	0.047	0.360	0.136
4 except Marine	0.40	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.060	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.060	0.06	0.033	0.059	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.033	0.059	0.065

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

402.1.4 Total UA alternative. If the total building thermal envelope UA (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table 402.1.3 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table 402.1.1. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

402.2 Specific insulation requirements. (Prescriptive).

402.2.1 Ceilings with attic spaces. When Section 402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

402.2.2 Ceilings without attic spaces. Where Section 402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m²) of ceiling area.

402.2.3 Mass walls. Mass walls for the purposes of this Chapter shall be considered walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs. The provisions of Section 402.1.1 for mass walls shall be applicable when at least 50 percent of the required insulation R-value is on the exterior of, or integral to, the wall. Walls that do not meet this criterion for insulation placement shall meet the wood frame wall insulation requirements of Section 402.1.1.

Exception: For walls that do not meet the criterion for insulation placement, the minimum added insulation R-value shall be permitted to be:

1. R-value of 4 in Climate Zone 1.
2. R-value of 6 in Climate Zone 2.
3. R-value of 8 in Climate Zone 3.

402.2.4 Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table 402.2.4 or shall meet the U-factor requirements in Table 402.1.3. The calculation of the U-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

TABLE 402.2.4
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION (R-VALUE)

WOOD FRAME R-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT R-VALUE ^a
Steel Truss Ceilings^b	
R-30	R - 38 or R - 30 + 3 or R - 26 + 5
R-38	R - 49 or R - 38 + 3
R-49	R-38+5
Steel Joist Ceilings^b	
R-30	R - 38 in 2x4 or 2x6 or 2x8 R - 49 in any framing
R-38	R - 49 in 2x4 or 2x6 or 2x8 or 2x10
Steel Framed Wall	
R-13	R - 13 + 5 or R - 15 + 4 or R - 21 + 3
R-19	R - 13 + 9 or R - 19 + 8 or R - 25 + 7
R-21	R - 13 + 10 or R - 19 + 9 or R - 25 + 8
Steel Joist Floor	
R-13	R - 19 in 2x6 R - 19 + 6 in 2x8 or 2x10
R-19	R - 19 + 6 in 2x6 R - 19 + 12 in 2x8 or 2x10

- a. Cavity insulation R-value is listed first, followed by continuous insulation R-value.
b. Insulation exceeding the height of the framing shall cover the framing.

402.2.5 Floors. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

402.2.6 Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections 402.1.1 and 402.2.5.

402.2.7 Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table 402.1.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table 402.1.1 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

402.2.8 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous vapor retarder. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

402.2.9 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

402.2.10 Thermally isolated sunroom insulation. The minimum ceiling insulation *R*-values shall be *R*-19 in zones 1 through 4 and *R*-24 in zones 5 through 8. The minimum wall *R*-value shall be *R*-13 in all zones. New wall(s) separating a sunroom from conditioned space shall meet the building thermal envelope requirements.

402.3 Fenestration. (Prescriptive).

402.3.1 *U*-factor. An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

402.3.2 Glazed fenestration SHGC. An area-weighted average of fenestration products more than 50 percent glazed shall be permitted to satisfy the SHGC requirements.

402.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor and SHGC requirements in Section 402.1.1.

402.3.4 Opaque door exemption. One opaque door assembly is exempted from the *U*-factor requirement in Section 402.1.1.

402.3.5 Thermally isolated sunroom *U*-factor. For Zones 4 through 8, the maximum fenestration *U*-factor shall be 0.50 and the maximum skylight *U*-factor shall be 0.75. New windows and doors separating the sunroom from conditioned space shall meet the building thermal envelope requirements.

402.3.6 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and SHGC in Table 402.1.1.

402.4 Air leakage. (Mandatory).

402.4.1 Building thermal envelope. The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Other sources of infiltration.

402.4.2 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exceptions: Site-built windows, skylights and doors.

402.4.3 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces by being:

1. IC-rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space; or

2. IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity; or
3. Located inside an airtight sealed box with clearances of at least 0.5 inch (12.7 mm) from combustible material and 3 inches (76 mm) from insulation.

402.5 Moisture control. (Mandatory). The building design shall not create conditions of accelerated deterioration from moisture condensation. Above-grade frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder. The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation.

Exceptions:

1. In construction where moisture or its freezing will not damage the materials.
2. Frame walls, floors and ceilings in jurisdictions in Zones 1, 2, 3, 4A and 4B. (Crawl space floor vapor retarders are not exempted.)
3. Where other approved means to avoid condensation are provided.

402.6 Maximum fenestration U-factor and SHGC. (Mandatory). The area weighted average maximum fenestration U-factor permitted using trade offs from Section 402.1.4 or Section 404 shall be 0.48 in zones 4 and 5 and 0.40 in zones 6 through 8 for vertical fenestration, and 0.75 in zones 4 through 8 for skylights. The area weighted average maximum fenestration SHGC permitted using trade-offs from Section 404 in Zones 1 through 3 shall be 0.50.

SECTION 403 SYSTEMS (Mandatory)

403.1 Controls. At least one thermostat shall be provided for each separate heating and cooling system.

403.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

403.2 Ducts.

403.2.1 Insulation. Supply and return ducts shall be insulated to a minimum of R-8: Ducts in floor trusses shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

403.2.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.1 of the *International Residential Code*.

403.2.3 Building cavities. Building framing cavities shall not be used as supply ducts.

403.3 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-2.

403.4 Circulating hot water systems. All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

403.5 Mechanical ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

403.6 Equipment sizing. Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code*.

SECTION 404 SIMULATED PERFORMANCE ALTERNATIVE (Performance)

404.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, and service water heating energy only.

404.2 Mandatory requirements. Compliance with this Section requires that the criteria of Sections 401, 402.4, 402.5, 402.6 and 403 be met.

404.3 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: Jurisdictions that require site energy (1kWh = 3,413 Btu) rather than energy cost as the metric of comparison.

404.4 Documentation.

404.4.1 Compliance software tools. Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code official.

404.4.2 Compliance report. Compliance software tools shall generate a report that documents that the proposed design has annual energy costs less than or equal to the annual energy costs of the standard reference design. The compliance documentation shall include the following information:

1. Address of the residence;
2. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table 404.5.2(1). The inspection checklist shall show the estimated annual energy cost for both

the standard reference design and the proposed design;

3. Name of individual completing the compliance report; and
4. Name and version of the compliance software tool.

404.4.3 Additional documentation. The code official shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the standard reference design.
2. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table 404.5.2(1).

404.5 Calculation procedure.

404.5.1 General. Except as specified by this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

404.5.2 Residence specifications. The standard reference design and proposed design shall be configured and analyzed as specified by Table 404.5.2(1). Table 404.5.2(1) shall include by reference all notes contained in Table 402.1.1.

404.6 Calculation software tools.

404.6.1 Minimum capabilities. Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

1. Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure shall not allow the user to directly modify the building component characteristics of the standard reference design.
2. Calculation of whole-building (as a single zone) sizing for the heating and cooling equipment in the standard reference design residence in accordance with Section M1401.3 of the *International Residential Code*.
3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air conditioning equipment based on climate and equipment sizing.
4. Printed code official inspection checklist listing each of the proposed design component characteristics from Table 404.5.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (e.g. R-Value, U-Factor, SHGC, HSPF, AFUE, SEER, EF, etc.).

404.6.2 Specific approval. Performance analysis tools meeting the applicable sections of 404 shall be permitted to be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The code

official shall be permitted to approve tools for a specified application or limited scope.

404.6.3 Input values. When calculations require input values not specified by Sections 402, 403 and 404, those input values shall be taken from an approved source.

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame Gross area: same as proposed U-Factor: from Table 402.1.3 Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed As proposed
Basement and crawl-space walls	Type: same as proposed Gross area: same as proposed U-Factor: from Table 402.1.3 with insulation layer on interior side of walls	As proposed As proposed As proposed
Above-grade floors	Type: wood frame Gross area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed
Ceilings	Type: wood frame Gross area: same as proposed U-Factor: from Table 402.1.3	As proposed As proposed As proposed
Roofs	Type: composition shingle on wood sheathing Gross area: same as proposed Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed
Attics	Type: vented with aperture = 1 ft ² per 300 ft ² ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
Doors	Area: 40 ft ² Orientation: North U-factor: same as fenestration from Table 402.1.3	As proposed As proposed As proposed
Glazing ^a	Total area ^b = (a) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area (b) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area Orientation: equally distributed to four cardinal compass orientations (N, E, S, & W) U-factor: from Table 402.1.2 SHGC: From Table 402.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85 External shading: none	As proposed As proposed As proposed As proposed Same as standard reference design ^c As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

(continued)

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS—continued

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Specific Leakage Area (SLA) ^d = 0.00036 assuming no energy recovery	For residences that are not tested, the same as the standard reference design For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate ^e but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate ^e combined with the mechanical ventilation rate, ^f which shall not be less than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N _{br} = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = $0.03942 \times CFA + 29.565 \times (N_{br} + 1)$ where: CFA = conditioned floor area N _{br} = number of bedrooms	As proposed
Internal gains	IGain = $17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element ^g but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air For masonry basement walls, as proposed, but with insulation required by Table 402.1.3 located on the interior side of the walls For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed As proposed As proposed
Heating systems ^{h, i}	Fuel type: same as proposed design Efficiencies: Electric: air-source heat pump with prevailing federal minimum efficiency Nonelectric furnaces: natural gas furnace with prevailing federal minimum efficiency Nonelectric boilers: natural gas boiler with prevailing federal minimum efficiency Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed As proposed As proposed As proposed As proposed
Cooling systems ^{h, j}	Fuel type: Electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed As proposed As proposed

(continued)

TABLE 404.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS—continued

Service Water Heating ^{h,k}	Fuel type: same as proposed design Efficiency: in accordance with prevailing Federal minimum standards Use: gal/day = 30 + 10 × N _{br} Tank temperature: 120°F	As proposed As proposed Same as standard reference Same as standard reference
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies	Same as standard reference design, except as specified by Table 404.5.2(2)
Thermostat	Type: manual, cooling temperature set point = 78°F; heating temperature set point = 68°F	Same as standard reference design

For SI: 1 square foot = 0.93 m²; 1 British thermal unit = 1055 J; 1 pound per square foot = 4.88 kg/m²; 1 gallon (U.S.) = 3.785 L; °C = (°F-32)/1.8.

- a. Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight-transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.

- b. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:

$$AF = A_s \times FA \times F$$

where:

AF = Total glazing area.

A_s = Standard reference design total glazing area.

FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 x below-grade boundary wall area).

F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

- i. For fenestrations facing within 15 degrees (0.26 rad) of true south that are directly coupled to thermal storage mass, the winter interior shade fraction shall be permitted to be increased to 0.95 in the proposed design.

- d. Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:

$$SLA = L/CFA$$

where L and CFA are in the same units.

- e. Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2001 ASHRAE *Handbook of Fundamentals*, Chapter 26, page 26.21, Equation 40 (Sherman-Grimsrud model) or the equivalent shall be used to determine the energy loads resulting from infiltration.
- f. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals* page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
- g. Thermal Storage Element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
- h. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
- i. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.
- j. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
- k. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum Energy Factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

**TABLE 404.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS^a**

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION:	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS ^b
Distribution system components located in unconditioned space	0.80	0.95
Distribution systems entirely located in conditioned space ^c	0.88	1.00
Proposed "reduced leakage" with entire air distribution system located in the conditioned space ^d	0.96	—
Proposed "reduced leakage" air distribution system with components located in the unconditioned space	0.88	—
"Ductless" systems ^e	1.00	—

For SI: 1 cubic foot per minute = 0.47 L/s; 1 square foot = 0.093 m²; 1 pound per square inch = 6895 Pa; 1 inch water gauge = 1250 Pa.

- a. Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
- b. Hydronic Systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced air flows to maintain space temperatures.
- c. Entire system in conditioned space shall mean that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.
- d. Proposed "reduced leakage" shall mean leakage to outdoors not greater than 3 cfm per 100 ft² of conditioned floor area and total leakage not greater than 9 cfm per 100 ft² of conditioned floor area at a pressure differential of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft² of conditioned floor area at a pressure difference of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to outdoors. This performance shall be specified as required in the construction documents and confirmed through field-testing of installed systems as documented by an approved independent party.
- e. Ductless systems may have forced airflow across a coil but shall not have any ducted airflows external to the manufacturer's air handler enclosure.

CHAPTER 5

COMMERCIAL ENERGY EFFICIENCY

This chapter has been reformatted; some deletions are not marked.

SECTION 501 GENERAL

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. These commercial buildings shall meet either the requirements of ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings*, or the requirements contained in this chapter.

501.2 Application. The requirements in Sections 502 (Building envelope), 503 (Building mechanical systems), 504 (Service water heating) and 505 (Lighting) shall each be satisfied on an individual basis. Where one or more of these sections is not satisfied, compliance for that section(s) shall be demonstrated in accordance with the applicable provisions of ASHRAE/IESNA 90.1.

Exception: Buildings conforming to Section 506, provided Sections 502.4, 502.5, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied.

SECTION 502 BUILDING ENVELOPE REQUIREMENTS

502.1 General. (Prescriptive).

502.1.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Tables 502.2(1) and 502.3 based on the climate zone specified in Chapter 3. Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of ASHRAE/IESNA 90.1.

502.2 Specific insulation requirements (Prescriptive). Opaque assemblies shall comply with Table 502.2(1).

502.2.1 Roof assembly. The minimum thermal resistance (R -value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 502.2(1), based on construction materials used in the roof assembly.

Exception: Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25.4 mm) or less and where the area weighted U -factor is equivalent to the same assembly with the R -value specified in Table 502.2(1).

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

502.2.2 Classification of walls. Walls associated with the building envelope shall be classified in accordance with Section 502.2.2.1 or 502.2.2.2.

502.2.2.1 Above-grade walls. Above-grade walls are those walls covered by Section 502.2.3 on the exterior of

the building and completely above grade or walls that are more than 15 percent above grade.

502.2.2.2 Below-grade walls. Below-grade walls covered by Section 502.2.4 are basement or first-story walls associated with the exterior of the building that are at least 85 percent below grade.

502.2.3 Above-grade walls. The minimum thermal resistance (R -value) of the insulating material(s) installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table 502.2(1), based on framing type and construction materials used in the wall assembly. The R -value of integral insulation installed in concrete masonry units (CMU) shall not be used in determining compliance with Table 502.2(1). "Mass walls" shall include walls weighing at least (1) 35 pounds per square foot (170 kg/m²) of wall surface area or (2) 25 pounds per square foot (120 kg/m²) of wall surface area if the material weight is not more than 120 pounds per cubic foot (1,900 kg/m³).

502.2.4 Below-grade walls. The minimum thermal resistance (R -value) of the insulating material installed in, or continuously on, the below-grade walls shall be as specified in Table 502.2(1), and shall extend to a depth of 10 feet (3048 mm) below the outside finish ground level, or to the level of the floor, whichever is less.

502.2.5 Floors over outdoor air or unconditioned space. The minimum thermal resistance (R -value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Table 502.2(1), based on construction materials used in the floor assembly.

"Mass floors" shall include floors weighing at least (1) 35 pounds per square foot (170 kg/m²) of floor surface area or (2) 25 pounds per square foot (120 kg/m²) of floor surface area if the material weight is not more than 12 pounds per cubic foot (1,900 kg/m³).

502.2.6 Slabs on grade. The minimum thermal resistance (R -value) of the insulation around the perimeter of unheated or heated slab-on-grade floors shall be as specified in Table 502.2(1). The insulation shall be placed on the outside of the foundation or on the inside of a foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table.

502.2.7 Opaque doors. Opaque doors (doors having less than 50 percent glass area) shall meet the applicable requirements for doors as specified in Table 502.2(1) and be considered as part of the gross area of above-grade walls that are part of the building envelope.

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS – OPAQUE ASSEMBLIES

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Roofs								
Insulation entirely above deck	R-15 ci	R-15 ci	R-15 ci	R-15 ci	R-20 ci	R-20 ci	R-25 ci	R-25 ci
Metal buildings (with R-5 thermal blocks ^a) ^b	R-19 + R-10	R-19	R-19	R-19	R-19	R-19	R-19 + R-10	R-19 + R-10
Attic and other	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38
Walls, Above Grade								
Mass	NR	NR	R-5.7 ci ^c	R-5.7 ci ^c	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-13.3 ci
Metal building ^b	R-13	R-13	R-13	R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13 + R-13
Metal framed	R-13	R-13	R-13	R-13	R-13 + R-3.8 ci	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-7.5 ci
Walls, Below Grade								
Below grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5 ci	R-7.5 ci
Floors								
Mass	NR	R-5 ci	R-5 ci	R-10 ci	R-10 ci	R-10 ci	R-15 ci	R-15 ci
Joist/Framing	NR	R-19	R-19	R-19	R-19	R-30	R-30	R-30
Slab-on-Grade Floors								
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 24 in. below	R-10 for 36 in. below	R-10 for 36 in. below	R-10 for 48 in. below			
Opaque Doors								
Swinging	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.50
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-0.50	U-0.50	U-0.50

For SI: 1 inch = 25.4 mm.

ci - Continuous Insulation

NR - No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci may be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-ft² F.

d. When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Insulation is not required for mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.

TABLE 502.2(2)
METAL BUILDING ASSEMBLY DESCRIPTIONS

ROOFS	DESCRIPTION	REFERENCE
R-19 + R-10	Filled cavity roof. Thermal blocks are a minimum, R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin. This construction is R-10 insulation batts draped perpendicularly over the purlins, with enough looseness to allow R-19 batt to be laid above it, parallel to the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins. In the metal building industry, this is known as the "sag and bag" insulation system.	ASHRAE/IESNA 90.1 Table A2.3
R-19	Standing seam with single insulation layer. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1 in. beyond the width of the purlin on each side, perpendicular to the purlin. This construction R-19 insulation batts draped perpendicularly over the purlins. Thermal blocks are then placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3
Walls		
R-13	Single insulation layer The first layer of R-13 insulation batts is installed continuously perpendicular to the girts and is compressed as the metal skin is attached to the girts.	ASHRAE/IESNA 90.1 Table A3.2
R-13 + R-13	Double insulation layer The first layer of R-13 insulation batts is installed continuously perpendicular to the girts, and is compressed as the metal skin is attached to the girts. The second layer of R-13 insulation batts is installed within the framing cavity.	ASHRAE/IESNA 90.1 Table A3.2

For SI: 1 inch = 25.4 mm.

502.3 Fenestration. (Prescriptive). Fenestration shall comply with Table 502.3.

502.3.1 Maximum area. The vertical fenestration area (not including opaque doors) shall not exceed the percentage of the gross wall area specified in Table 502.3. The skylight area shall not exceed the percentage of the gross roof area specified in Table 502.3.

502.3.2 Maximum U-factor and SHGC. For vertical fenestration, the maximum U-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3, based on the window projection factor. For skylights, the maximum U-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3.

The window projection factor shall be determined in accordance with Equation 5-1.

$$PF = A/B \quad \text{(Equation 5-1)}$$

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different PF values, they shall each be evaluated separately, or an area-weighted PF value shall be calculated and used for all windows and glass doors.

502.4 Air leakage. (Mandatory).

502.4.1 Window and door assemblies. The air leakage of window and sliding or swinging door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and labeled and certified by the manufacturer and shall not exceed the values in Section 402.4.2.

Exception: Site-constructed windows and doors that are weatherstripped or sealed in accordance with Section 502.4.3.

502.4.2 Curtain wall, storefront glazing and commercial entrance doors. Curtain wall, storefront glazing and commercial-glazed swinging entrance doors and revolving doors shall be tested for air leakage at 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283.

**TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**

CLIMATE ZONE	1	2	3	4 except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
U-Factor								
Framing materials other than metal with or without metal reinforcement or cladding								
U-Factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain Wall/Storefront U-Factor	1.20	0.70	0.60	0.50	0.45	0.45	0.45	0.45
Entrance Door U-Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other U-Factor ^a	1.20	0.75	0.65	0.55	0.55	0.55	0.50	0.50
SHGC-All Frame Types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	NR	NR
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
Glass								
U-Factor	1.60	1.05	0.90	0.60	0.60	0.60	0.60	0.60
SHGC	0.40	0.40	0.40	0.40	0.40	0.40	NR	NR
Plastic								
U-Factor	1.90	1.90	1.30	1.30	1.30	0.90	0.90	0.60
SHGC	0.35	0.35	0.35	0.62	0.62	0.62	NR	NR

NR = No requirement.

PF = Projection factor (See Section 502.3.2)

a. All others includes operable windows, fixed windows and non-entrance doors.

For curtain walls and storefront glazing, the maximum air leakage rate shall be 0.3 cubic foot per minute per square foot (cfm/ft²) (5.5 m³/h × m²) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft² (18.3 m³/h × m²) of door area when tested in accordance with ASTM E 283.

502.4.3 Sealing of the building envelope. Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

502.4.4 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per

square foot (6.8 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

Exception: Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.

502.4.5 Loading dock weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

502.4.6 Vestibules. A door that separates conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time.

Exceptions:

1. Buildings in Climate Zones 1 and 2 as indicated in Figure 301.1 and Table 301.1.
2. Doors not intended to be used as a building entrance door, such as doors to mechanical or electrical equipment rooms.

3. Doors opening directly from a sleeping unit or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m²) in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

502.4.7 Recessed luminaires. When installed in the building envelope, recessed luminaires shall meet one of the following requirements:

1. Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity and sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC or non-IC rated, installed inside a sealed box constructed from a minimum 0.5-inch-thick (12.7 mm) gypsum wallboard or constructed from a pre-formed polymeric vapor barrier, or other air-tight assembly manufactured for this purpose, while maintaining required clearances of not less than 0.5 inch (12.7 mm) from combustible material and not less than 3 inches (76 mm) from insulation material.
3. Type IC rated, in accordance with ASTM E 283 admitting no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. The luminaire shall be tested at 1.57 psf (75 Pa) pressure difference and shall be labeled.

502.5 Moisture control. (Mandatory). All framed walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder having a permeance rating of 1 perm (5.7×10^{-11} kg/Pa · s · m²) or less, when tested in accordance with the desiccant method using Procedure A of ASTM E 96. The vapor retarder shall be installed on the warm-in-winter side of the insulation.

Exceptions:

1. Buildings located in Climate Zones 1 through 3 as indicated in Figure 301.1 and Table 301.1.
2. In construction where moisture or its freezing will not damage the materials.
3. Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities are provided.

SECTION 503 BUILDING MECHANICAL SYSTEMS

503.1 General. Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Section 503.2 (referred to as the mandatory provisions) and either:

1. Section 503.3 (Simple systems), or
2. Section 503.4 (Complex systems).

503.2 Provisions applicable to all mechanical systems. (Mandatory).

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE *Fundamentals Handbook*. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an approved equivalent computation procedure, using the design parameters specified in Chapter 3.

503.2.2 Equipment and system sizing. Equipment and system sizing. Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with Section 503.2.1. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Exceptions:

1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating.
2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that have the capability to sequence the operation of each unit based on load.

503.2.3 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6), 503.2.3(7), 503.2.3(8), 503.2.3(9), 503.2.3(10) and 503.2.3(11) when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through certification under an approved certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrate that the combined efficiency of the specified components meets the requirements herein.

Exception: Equipment listed in Table 503.2.3(7) not designed for operation at ARI Standard test conditions of 44°F (7°C) leaving chilled water temperature and 85°F (29°C) entering condenser water temperature shall have a minimum full load COP and IPLV rating as shown in Tables 503.2.3(8) through 503.2.3(10) as applicable. The table values are only applicable over the following full load design ranges:

Leaving Chilled	
Water Temperature:	40 to 48°F (4 to 9°C)
Entering Condenser	
Water Temperature:	75 to 85°F (24 to 29°C)

Condensing Water
Temperature Rise: 5 to 15°F ($\Delta 3$ to $\Delta 8^\circ\text{C}$)

Chillers designed to operate outside of these ranges are not covered by this code.

503.2.4 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as required in Section 503.2.4.1, 503.2.4.2, 503.2.4.3, 503.2.4.4, 503.4.1, 503.4.2, 503.4.3 or 503.4.4.

503.2.4.1 Thermostatic controls. The supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls capable of responding to temperature within the zone. Where humidification or dehumidification or both is provided, at least one humidity control device shall be provided for each humidity control system.

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses or gains or both serving one or more perimeter zones also served by an interior system provided:

1. The perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation (within +/- 45 degrees) (0.8 rad) for more than 50 contiguous feet (15.2 m); and

2. The perimeter system heating and cooling supply is controlled by a thermostat(s) located within the zone(s) served by the system.

503.2.4.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation when the heat pump can meet the heating load.

503.2.4.2 Set point overlap restriction. Where used to control both heating and cooling, zone thermostatic controls shall provide a temperature range or deadband of at least 5°F (2.8°C) within which the supply of heating and cooling energy to the zone is capable of being shut off or reduced to a minimum.

Exception: Thermostats requiring manual change-over between heating and cooling modes.

503.2.4.3 Off-hour controls. Each zone shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

Exceptions:

1. Zones that will be operated continuously.
2. Zones with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch.

TABLE 503.2.3(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS,
ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Air conditioners, Air cooled	< 65,000 Btu/h ^d	Split system	10.0 SEER	ARI 210/240
		Single package	9.7 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	10.3 EER ^c	ARI 340/360
		Split system and single package	9.7 EER ^c	
		Split system and single package	9.5 EER ^c 9.7 IPLV ^c	
Split system and single package	9.2 EER ^c 9.4 IPLV ^c			
Split system and single package	9.2 EER ^c 9.4 IPLV ^c			
Air conditioners, Water and evaporatively cooled	< 65,000 Btu/h	Split system and single package	12.1 EER	ARI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	11.5 EER ^c	ARI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and single package	11.0 EER ^c	
	≥ 240,000 Btu/h	Split system and single package	11.0 EER ^c 10.3 IPLV ^c	

^aor SI: 1 British thermal unit per hour = 0.2931 W.

Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. IPLVs are only applicable to equipment with capacity modulation.

c. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

d. Single-phase air-cooled air conditioners < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA), SEER values are those set by NAECA.

TABLE 503.2.3(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY
OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Air cooled (Cooling mode)	< 65,000 Btu/h ^d	Split system	10.0 SEER	ARI 210/240
		Single package	9.7 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	10.1 EER ^c	ARI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and single package	9.3 EER ^c	
	≥ 240,000 Btu/h	Split system and single package	9.0 EER ^c 9.2 IPLV ^c	
Water source (Cooling mode)	< 17,000 Btu/h	86°F entering water	11.2 EER	ARI/ASHRAE-13256-1
	≥ 17,000 Btu/h and < 135,000 Btu/h	86°F entering water	12.0 EER	ARI/ASHRAE-13256-1
Groundwater source (Cooling mode)	< 135,000 Btu/h	59°F entering water	16.2 EER	ARI/ASHRAE-13256-1
Ground source (Cooling mode)	< 135,000 Btu/h	77°F entering water	13.4 EER	ARI/ASHRAE 13256-1
Air cooled (Heating mode)	< 65,000 Btu/h ^d (Cooling capacity)	Split system	6.8 HSPF	ARI 210/240
		Single package	6.6 HSPF	
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.2 COP	ARI 340/360
≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.1 COP		
Water source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	68°F entering water	4.2 COP	ARI/ASHRAE-13256-1
Groundwater source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	50°F entering water	3.6 COP	ARI/ASHRAE-13256-1
Ground Source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	32°F entering water	3.1 COP	ARI/ASHRAE-13256-1

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W.

db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
- c. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.
- d. Single-phase air-cooled heat pumps < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA), SEER and HSPF values are those set by NAECA.

TABLE 503.2.3(3)
PACKAGED TERMINAL AIR CONDITIONERS AND
PACKAGED TERMINAL HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
PTAC (Cooling mode) New construction	All capacities	95°F db outdoor air	12.5 - (0.213 · Cap/1000) EER	ARI 310/380
PTAC (Cooling mode) Replacements ^c	All capacities	95°F db outdoor air	10.9 - (0.213 · Cap/1000) EER	
PTHP (Cooling mode) New construction	All capacities	95°F db outdoor air	12.3 - (0.213 · Cap/1000) EER	
PTHP (Cooling mode) Replacements ^c	All capacities	95°F db outdoor air	10.8 - (0.213 · Cap/1000) EER	
PTHP (Heating mode) New construction	All capacities	—	3.2 - (0.026 · Cap/1000) COP	
PTHP (Heating mode) Replacements ^c	All capacities	—	2.9 - (0.026 · Cap/1000) COP	

For SI: °C - [(°F) - 32] / 1.8, 1 British thermal unit per hour - 0.2931 W

db = dry-bulb temperature, °F

wb = wet-bulb temperature, °F

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
- c. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

TABLE 503.2.3(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS,
WARM AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^{a, b}	TEST PROCEDURE ^a
Warm air furnaces, gas fired	< 225,000 Btu/h	—	78% AFUE or 80% E_t^c	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity ^c	80% E_t^d	ANSI Z21.47
Warm air furnaces, oil fired	< 225,000 Btu/h	—	78% AFUE or 80% E_t^e	DOE 10 CFR Part 430 or UL 727
	≥ 225,000 Btu/h	Maximum capacity ^b	81% E_t^f	UL 727
Warm air duct furnaces, gas fired	All capacities	Maximum capacity ^b	80% E_c	ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity ^b	80% E_c	ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity ^b	80% E_c	UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. Minimum and maximum ratings as provided for and allowed by the unit's controls.
- c. Combination units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.
- d. E_t = Thermal efficiency. See test procedure for detailed discussion.
- e. E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.
- f. E_c = Combustion efficiency. Units must also include an IID, have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
- g. E_t = Thermal efficiency. Units must also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

TABLE 503.2.3(5)
BOILERS, GAS- AND OIL-FIRED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE ^f	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^{c, d, e}	TEST PROCEDURE ^a
Boilers, Gas fired	< 300,000 Btu/h	Hot water	80% AFUE	DOE 10 CFR Part 430
		Steam	75% AFUE	
	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Minimum capacity ^b	75% E_t	H.I. HBS
		> 2,500,000 Btu/h ^f	Hot water	
Steam	80% E_c			
Boilers, Oil fired	< 300,000 Btu/h	—	80% AFUE	
	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Minimum capacity ^b	78% E_t	H.I. HBS
		> 2,500,000 Btu/h ^f	Hot water	
	Steam		83% E_c	
Boilers, Oil fired (Residual)	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Minimum capacity ^b	78% E_t	
		> 2,500,000 Btu/h ^f	Hot water	83% E_c
	Steam		83% E_c	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. Minimum ratings as provided for and allowed by the unit's controls.
- c. E_c = Combustion efficiency (100 percent less flue losses). See reference document for detailed information.
- d. E_t = Thermal efficiency. See reference document for detailed information.
- e. Alternative test procedures used at the manufacturer's option are ASME PTC-4.1 for units greater than 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.
- f. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers, and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

TABLE 503.2.3(6)
CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Condensing units, air cooled	≥ 135,000 Btu/h	10.1 EER 11.2 IPLV	ARI 365
Condensing units, water or evaporatively cooled	≥ 135,000 Btu/h	13.1 EER 13.1 IPLV	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. IPLVs are only applicable to equipment with capacity modulation.

TABLE 503.2.3(7)
WATER CHILLING PACKAGES, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Air cooled, with condenser, electrically operated	< 150 tons	2.80 COP 2.80 IPLV	ARI 550/590
	≥ 150 tons	2.50 COP 2.50 IPLV	
Air cooled, without condenser, electrically operated	All capacities	3.10 COP 3.10 IPLV	ARI 550/590
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	4.20 COP 4.65 IPLV	
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 150 tons	4.45 COP 4.50 IPLV	ARI 550/590
	≥ 150 tons and < 300 tons	4.90 COP 4.95 IPLV	
	≥ 300 tons	5.50 COP 5.60 IPLV	
Water cooled, electrically operated, centrifugal	< 150 tons	5.00 COP 5.00 IPLV	ARI 550/590
	≥ 150 tons and < 300 tons	5.55 COP 5.55 IPLV	
	≥ 300 tons	6.10 COP 6.10 IPLV	
Air cooled, absorption single effect	All capacities	0.60 COP	ARI 560
Water cooled, absorption single effect	All capacities	0.70 COP	
Absorption double effect, indirect-fired	All capacities	1.00 COP 1.05 IPLV	
Absorption double effect, direct-fired	All capacities	1.00 COP 1.00 IPLV	

For SI: 1 ton = 3.517 kW. °C = [(°F) - 32]/1.8.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. The chiller equipment requirements do not apply for chillers used in low temperature applications where the design leaving fluid temperature is less than or equal to 40°F.

TABLE 503.2.3(8)
COPs AND IPLVs FOR NONSTANDARD CENTRIFUGAL CHILLERS < 150 TONS

CENTRIFUGAL CHILLERS < 150 TONS COP _{std} = 5.4								
Leaving chilled water temperature (°F)	Entering condenser water temperature (°F)	Lift ^a (°F)	Condenser flow rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Required COP and IPLV								
46	75	29	6.00	6.27	6.48	6.80	7.03	7.20
45	75	30	5.92	6.17	6.37	6.66	6.87	7.02
44	75	31	5.84	6.08	6.26	6.53	6.71	6.86
43	75	32	5.75	5.99	6.16	6.40	6.58	6.71
42	75	33	5.67	5.90	6.06	6.29	6.45	6.57
41	75	34	5.59	5.82	5.98	6.19	6.34	6.44
46	80	34	5.59	5.82	5.98	6.19	6.34	6.44
40	75	35	5.50	5.74	5.89	6.10	6.23	6.33
45	80	35	5.50	5.74	5.89	6.10	6.23	6.33
44	80	36	5.41	5.66	5.81	6.01	6.13	6.22
43	80	37	5.31	5.57	5.73	5.92	6.04	6.13
42	80	38	5.21	5.48	5.64	5.84	5.95	6.04
41	80	39	5.09	5.39	5.56	5.76	5.87	5.95
46	85	39	5.09	5.39	5.56	5.76	5.87	5.95
40	80	40	4.96	5.29	5.47	5.67	5.79	5.86
45	85	40	4.96	5.29	5.47	5.67	5.79	5.86
44	85	41	4.83	5.18	5.40	5.59	5.71	5.78
43	85	42	4.68	5.07	5.28	5.50	5.62	5.70
42	85	43	4.51	4.94	5.17	5.41	5.54	5.62
41	85	44	4.33	4.80	5.05	5.31	5.45	5.53
40	85	45	4.13	4.65	4.92	5.21	5.35	5.44
Condenser ΔT ^b			14.04	11.23	9.36	7.02	5.62	4.68

For SI: °C = [(°F) - 32] / 1.8, 1 gallon per minute = 3.785 L/min., 1 ton = 12,000 British thermal units per hour = 3.517 kW

a. Lift = Entering condenser water temperature (°F) - Leaving chilled water temperature (°F).

b. Condenser ΔT = Leaving condenser water temperature (°F) - Entering condenser water temperature (°F).

$$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)$$

where: X = Condenser ΔT + Lift

$$COP_{adj} = K_{adj} \times COP_{std}$$

TABLE 503.2.3(9)
COPs AND IPLVs FOR NONSTANDARD CENTRIFUGAL CHILLERS ≥ 150 TONS, ≤ 300 TONS

CENTRIFUGAL CHILLERS ≥ 150 Tons, ≤ 300 Tons COP _{std} = 5.55								
Leaving chilled water temperature (°F)	Entering condenser water temperature (°F)	Lift ^a (°F)	Condenser flow rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Required COP and IPLV								
46	75	29	6.17	6.44	6.66	6.99	7.23	7.40
45	75	30	6.08	6.34	6.54	6.84	7.06	7.22
44	75	31	6.00	6.24	6.43	6.71	6.90	7.05
43	75	32	5.91	6.15	6.33	6.58	6.76	6.89
42	75	33	5.83	6.07	6.23	6.47	6.63	6.75
41	75	34	5.74	5.98	6.14	6.36	6.51	6.62
46	80	34	5.74	5.98	6.14	6.36	6.51	6.62
40	75	35	5.65	5.90	6.05	6.26	6.40	6.51
45	80	35	5.65	5.90	6.05	6.26	6.40	6.51
44	80	36	5.56	5.81	5.97	6.17	6.30	6.40
43	80	37	5.46	5.73	5.89	6.08	6.21	6.30
42	80	38	5.35	5.64	5.8	6.00	6.12	6.20
41	80	39	5.23	5.54	5.71	5.91	6.03	6.11
46	85	39	5.23	5.54	5.71	5.91	6.03	6.11
40	80	40	5.10	5.44	5.62	5.83	5.95	6.03
45	85	40	5.10	5.44	5.62	5.83	5.95	6.03
44	85	41	4.96	5.33	5.55	5.74	5.86	5.94
43	85	42	4.81	5.21	5.42	5.66	5.78	5.86
42	85	43	4.63	5.08	5.31	5.56	5.69	5.77
41	85	44	4.45	4.93	5.19	5.46	5.60	5.69
40	85	45	4.24	4.77	5.06	5.35	5.50	5.59
Condenser ΔT ^b			14.04	11.23	9.36	7.02	5.62	4.68

For SI: °C = [(°F) - 32] / 1.8, 1 gallon per minute = 3.785 L/min., 1 ton = 12,000 British thermal units per hour = 3.517 kW

- a. Lift = Entering condenser water temperature (°F) - Leaving chilled water temperature (°F).
- b. Condenser ΔT = Leaving condenser water temperature (°F) - Entering condenser water temperature (°F).

$$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$$

where: X = Condenser ΔT + Lift COP_{adj} = K_{adj} x COP_{std}

TABLE 503.2.3(10)
COPs AND IPLVs FOR NONSTANDARD CENTRIFUGAL CHILLERS > 300 TONS

CENTRIFUGAL CHILLERS > 300 Tons COP _{std} = 6.1								
Leaving chilled water temperature (°F)	Entering condenser water temperature (°F)	Lift ^a (°F)	Condenser flow rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Required COP and IPLV								
46	75	29	6.80	7.11	7.35	7.71	7.97	8.16
45	75	30	6.71	6.99	7.21	7.55	7.78	7.96
44	75	31	6.61	6.89	7.09	7.40	7.61	7.77
43	75	32	6.52	6.79	6.98	7.26	7.45	7.60
42	75	33	6.43	6.69	6.87	7.13	7.31	7.44
41	75	34	6.33	6.60	6.77	7.02	7.18	7.30
46	80	34	6.33	6.60	6.77	7.02	7.18	7.30
40	75	35	6.23	6.50	6.68	6.91	7.06	7.17
45	80	35	6.23	6.50	6.68	6.91	7.06	7.17
44	80	36	6.13	6.41	6.58	6.81	6.95	7.05
43	80	37	6.02	6.31	6.49	6.71	6.85	6.94
42	80	38	5.90	6.21	6.40	6.61	6.75	6.84
41	80	39	5.77	6.11	6.30	6.52	6.65	6.74
46	85	39	5.77	6.11	6.30	6.52	6.65	6.74
40	80	40	5.63	6.00	6.20	6.43	6.56	6.65
45	85	40	5.63	6.00	6.20	6.43	6.56	6.65
44	85	41	5.47	5.87	6.10	6.33	6.47	6.55
43	85	42	5.30	5.74	5.98	6.24	6.37	6.46
42	85	43	5.11	5.60	5.86	6.13	6.28	6.37
41	85	44	4.90	5.44	5.72	6.02	6.17	6.27
40	85	45	4.68	5.26	5.58	5.90	6.07	6.17
Condenser ΔT ^b			14.04	11.23	9.36	7.02	5.62	4.68

For SI: °C = [(°F) - 32] / 1.8, 1 gallon per minute = 3.785 L/min., 1 ton = 12,000 British thermal units per hour = 3.517 kW

- a. Lift = Entering condenser water temperature (°F) - Leaving chilled water temperature (°F).
- b. Condenser ΔT = Leaving condenser water temperature (°F) - Entering condenser water temperature (°F).

$$K_{adj} = 6.1507 - 0.030244(X) + 0.0062692(X)^2 - 0.000045595(X)$$

where: X = Condenser ΔT + Lift

$$COP_{adj} = K_{adj} \times COP_{std}$$

TABLE 503.2.3(11)
PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED ^{a, b}	TEST PROCEDURE ^c
Propeller or axial fan cooling towers	All	95°F entering water 85°F leaving water 75°F wb outdoor air	≥ 38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan cooling towers	All	95°F entering water 85°F leaving water 75°F wb outdoor air	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Air cooled condensers	All	125°F condensing temperature R-22 test fluid 190°F entering gas temperature 15°F subcooling 95°F entering db	≥ 176,000 Btu/h · hp (69 COP)	ARI 460

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon per minute per horsepower = 0.846 L/s · kW, wb = wet-bulb temperature, °F

- a. For purposes of this table, cooling tower performance is defined as the maximum flow rating of the tower units (gpm) divided by the fan nameplate rated motor power units (hp).
- b. For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant units (Btu/h) divided by the fan nameplate rated motor power units (hp).
- c. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

503.2.4.3.1 Thermostatic setback capabilities. Thermostatic setback controls shall have the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C).

503.2.4.3.2 Automatic setback and shutdown capabilities. Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer capable of being adjusted to operate the system for up to 2 hours; or an occupancy sensor.

503.2.4.4 Shutoff damper controls. Both outdoor air supply and exhaust ducts shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

Exceptions:

1. Gravity dampers shall be permitted in buildings less than three stories in height.
2. Gravity dampers shall be permitted for buildings of any height located in climate zones 1, 2, and 3.
3. Gravity dampers shall be permitted for outside air intake or exhaust airflows of 300 cfm (14 m³/s) or less.

503.2.5 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the *International Mechanical Code*. Where mechanical venti-

lation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the *International Mechanical Code*.

503.2.6 Energy recovery ventilation systems. Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.36 m³/s) or greater and a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50 percent or more of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the energy recovery system to permit cooling with outdoor air where cooling with outdoor air is required.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.
2. Laboratory fume hood systems with a total exhaust rate of 15,000 cfm (7.08 m³/s) or less.
3. Laboratory fume hood systems with a total exhaust rate greater than 15,000 cfm (7.08 m³/s) that include at least one of the following features:
 - 3.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
 - 3.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) below room set point, cooled to no cooler than 3°F (1.7°C) above room set point, no humidification

added, and no simultaneous heating and cooling used for dehumidification control.

4. Systems serving spaces that are not cooled and are heated to less than 60°F (15.5°C).
5. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
6. Heating systems in climates with less than 3600 HDD.
7. Cooling systems in climates with a 1 percent cooling design wet-bulb temperature less than 64°F (17.7°C).
8. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

503.2.7 Duct and plenum insulation and sealing. All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in unconditioned spaces and with a minimum of R-8 insulation when located outside the building. When located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R-8 insulation.

Exceptions:

1. When located within equipment.
2. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (8°C).

All joints, longitudinal and transverse seams and connections in ductwork, shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes. Tapes and mastics used to seal ductwork shall be listed and labeled in accordance with UL 181A and shall be marked "181A-P" for pressure-sensitive tape, "181A-M" for mastic or "181A-H" for heat-sensitive tape. Tapes and mastics used to seal flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181B-FX" for pressure-sensitive tape or "181B-M" for mastic. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Unlisted duct tape is not permitted as a sealant on any duct.

503.2.7.1 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*.

503.2.7.1.1 Low-pressure duct systems. All longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches w.g. (500 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer's installation instructions. Pressure classifications specific to the duct system shall be clearly

indicated on the construction documents in accordance with the *International Mechanical Code*.

Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches w.g. (500 Pa) pressure classification.

503.2.7.1.2 Medium-pressure duct systems. All ducts and plenums designed to operate at a static pressure greater than 2 inches w.g. (500 Pa) but less than 3 inches w.g. (750 Pa) shall be insulated and sealed in accordance with Section 503.2.7. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the *International Mechanical Code*.

503.2.7.1.3 High-pressure duct systems. Ducts designed to operate at static pressures in excess of 3 inches w.g. (746 Pa) shall be insulated and sealed in accordance with Section 503.2.7. In addition, ducts and plenums shall be leak-tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual* with the rate of air leakage (*CL*) less than or equal to 6.0 as determined in accordance with Equation 5-2.

$$CL = F \times P^{0.65} \quad (\text{Equation 5-2})$$

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.

P = The static pressure of the test.

Documentation shall be furnished by the designer demonstrating that representative sections totaling at least 25 percent of the duct area have been tested and that all tested sections meet the requirements of this section.

503.2.8 Piping insulation. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 503.2.8.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Piping that conveys fluids that have a design operating temperature range between 55°F (13°C) and 105°F (41°C).
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
4. Runout piping not exceeding 4 feet (1219 mm) in length and 1 inch (25 mm) in diameter between the control valve and HVAC coil.

**TABLE 503.2.8
MINIMUM PIPE INSULATION^a
(thickness in inches)**

FLUID	NOMINAL PIPE DIAMETER	
	≤1.5"	> 1.5"
Steam	1½	3
Hot water	1	2
Chilled water, brine or refrigerant	1	1½

For SI: 1 inch = 25.4 mm, British thermal unit per inch/h · ft² · °F = W per 25 mm/K · m²

a. Based on insulation having a conductivity (k) not exceeding 0.27 Btu per inch/h · ft² · °F.

503.2.9 HVAC system completion. Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.

503.2.9.1 Air system balancing. Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 25 hp (18.6 kW) and larger.

503.2.9.2 Hydronic system balancing. Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.

503.2.9.3 Manuals. The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:

1. Equipment capacity (input and output) and required maintenance actions.
2. Equipment operation and maintenance manuals.
3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.
4. A complete written narrative of how each system is intended to operate.

503.3 Simple HVAC systems and equipment. (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), each serving one zone and controlled by a single thermostat in the zone served. It also applies to two-pipe heating systems serving one or more zones, where no cooling system is installed.

This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equip-

ment and distribution systems that provide cooling or cooling and heating which are covered by Section 503.4.

503.3.1 Economizers. Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1).

Economizers shall be capable of providing 100-percent outdoor air, even if additional mechanical cooling is required to meet the cooling load of the building. Systems shall provide a means to relieve excess outdoor air during economizer operation to prevent overpressurizing the building. The relief air outlet shall be located to avoid recirculation into the building. Where a single room or space is supplied by multiple air systems, the aggregate capacity of those systems shall be used in applying this requirement.

Exceptions:

1. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1) or 503.2.3(2) and meets or exceeds the minimum cooling efficiency requirement (EER) by the percentages shown in Table 503.3.1(2).
2. Systems with air or evaporatively cooled condensers and which serve spaces with open case refrigeration or that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.

**TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS**

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 3A, 4A, 7, 8	No requirement
2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h
5A, 6A	Economizers on all cooling systems ≥ 135,000 Btu/h

For SI: 1 British thermal unit per hour = 0.293 W.

**TABLE 503.3.1(2)
EQUIPMENT EFFICIENCY PERFORMANCE
EXCEPTION FOR ECONOMIZERS**

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

503.3.2 Hydronic system controls. Hydronic systems of at least 300,000 Btu/h (87,930 W) design output capacity supplying heated and chilled water to comfort conditioning systems shall include controls that meet the requirements of Section 503.4.3.

503.4 Complex HVAC systems and equipment. (Prescriptive). This section applies to buildings served by HVAC equipment and systems not covered in Section 503.3.

503.4.1 Economizers. Supply air economizers shall be provided on each cooling system according to Table 503.3.1(1). Economizers shall be capable of operating at 100 percent outside air, even if additional mechanical cooling is required to meet the cooling load of the building.

Exceptions:

1. Systems utilizing water economizers that are capable of cooling supply air by direct or indirect evaporation or both and providing 100 percent of the expected system cooling load at outside air temperatures of 50°F (10°C) dry bulb/45°F (7°C) wet bulb and below.
2. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1), 503.2.3(2), or 503.2.3(6) and meets or exceeds the minimum EER by the percentages shown in Table 503.3.1(2)
3. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(7) and meets or exceeds the minimum integrated part load value (IPLV) by the percentages shown in Table 503.3.1(2).

503.4.2 Variable air volume (VAV) fan control. Individual VAV fans with motors of 10 horsepower (7.5 kW) or greater shall be:

1. Driven by a mechanical or electrical variable speed drive; or
2. The fan motor shall have controls or devices that will result in fan motor demand of no more than 30 percent of their design wattage at 50 percent of design air flow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.

For systems with direct digital control of individual zone boxes reporting to the central control panel, the static pressure set point shall be reset based on the zone requiring the most pressure, i.e., the set point is reset lower until one zone damper is nearly wide open.

503.4.3 Hydronic systems controls. The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections 503.4.3.1 through 503.4.3.3. Hydronic heating systems comprised of multiple-packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls capable of sequencing operation of the boilers. Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h input design capacity shall include either a multistaged or modulating burner.

503.4.3.1 Three-pipe system. Hydronic systems that use a common return system for both hot water and chilled water are prohibited.

503.4.3.2 Two-pipe changeover system. Systems that use a common distribution system to supply both heated and chilled water shall be designed to allow a dead band between changeover from one mode to the other of at least 15°F (8.3°C) outside air temperatures; be designed to and provided with controls that will allow operation in one mode for at least 4 hours before changing over to the other mode; and be provided with controls that allow heating and cooling supply temperatures at the change-over point to be no more than 30°F (16.7°C) apart.

503.4.3.3 Hydronic (water loop) heat pump systems. Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F (11.1°C) between initiation of heat rejection and heat addition by the central devices. For Climate Zones 3 through 8 as indicated in Figure 301.1 and Table 301.1, if a closed-circuit cooling tower is used, either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower, or lower leakage positive closure dampers shall be provided. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the cooling tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 horsepower (hp) (7.5 kW) shall have a two-position valve.

Exception: Where a system loop temperature optimization controller is installed and can determine the most efficient operating temperature based on real time conditions of demand and capacity, dead bands of less than 20°F (11.1°C) shall be permitted.

503.4.3.4 Part load controls. Hydronic systems greater than or equal to 300,000 Btu/h (87,930 W) in design output capacity supplying heated or chilled water to comfort conditioning systems shall include controls that have the capability to:

1. Automatically reset the supply-water temperatures using zone-return water temperature, building-return water temperature, or outside air temperature as an indicator of building heating or cooling demand. The temperature shall be capable of being reset by at least 25 percent of the design supply-to-return water temperature difference; or
2. Reduce system pump flow by at least 50 percent of design flow rate utilizing adjustable speed drive(s) on pump(s), or multiple-staged pumps where at least one-half of the total pump horsepower is capable of being automatically turned off or control valves designed to modulate or step down, and close, as a function of load, or other approved means.

503.4.3.5 Pump isolation. Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential, shall be considered as one chiller.

Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.

503.4.4 Heat rejection equipment fan speed control. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exception: Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables 503.2.3(6) through 503.2.3(11).

503.4.5 Requirements for complex mechanical systems serving multiple zones. Sections 503.4.5.1 through 503.4.5.3 shall apply to complex mechanical systems serving multiple zones. Supply air systems serving multiple zones shall be VAV systems which, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each zone to one of the following before reheating, recooling or mixing takes place:

1. Thirty percent of the maximum supply air to each zone.
2. Three hundred cfm (142 L/s) or less where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate.
3. The minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.

Exception: The following define when individual zones or when entire air distribution systems are exempted from the requirement for VAV control:

1. Zones where special pressurization relationships or cross-contamination requirements are such that VAV systems are impractical.
2. Zones or supply air systems where at least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source.
3. Zones where special humidity levels are required to satisfy process needs.
4. Zones with a peak supply air quantity of 300 cfm (142 L/s) or less and where the flow rate is less than 10 percent of the total fan system supply airflow rate.
5. Zones where the volume of air to be reheated, re-cooled or mixed is no greater than the volume of outside air required to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.

6. Zones or supply air systems with thermostatic and humidistatic controls capable of operating in sequence the supply of heating and cooling energy to the zone(s) and which are capable of preventing reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.

503.4.5.1 Single duct variable air volume (VAV) systems, terminal devices. Single duct VAV systems shall use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.

503.4.5.2 Dual duct and mixing VAV systems, terminal devices. Systems that have one warm air duct and one cool air duct shall use terminal devices which are capable of reducing the flow from one duct to a minimum before mixing of air from the other duct takes place.

503.4.5.3 Single fan dual duct and mixing VAV systems, economizers. Individual dual duct or mixing heating and cooling systems with a single fan and with total capacities greater than 90,000 Btu/h [(26 375 W) 7.5 tons] shall not be equipped with air economizers.

503.4.6 Heat recovery for service water heating. Condenser heat recovery shall be installed for heating or reheating of service hot water provided the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h.

The required heat recovery system shall have the capacity to provide the smaller of:

1. Sixty percent of the peak heat rejection load at design conditions; or
2. The preheating required to raise the peak service hot water draw to 85°F (29°C).

Exceptions:

1. Facilities that employ condenser heat recovery for space heating or reheat purposes with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
2. Facilities that provide 60 percent of their service water heating from site solar or site recovered energy or from other sources.

**SECTION 504
SERVICE WATER HEATING
(Mandatory)**

504.1 General. This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping.

504.2 Service water-heating equipment performance efficiency. Water-heating equipment and hot water storage tanks shall meet the requirements of Table 504.2. The efficiency shall be verified through data furnished by the manufacturer or through certification under an approved certification program.

504.3 Temperature controls. Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).

504.4 Heat traps. Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

504.5 Pipe insulation. For automatic-circulating hot water systems, piping shall be insulated with 1 inch (25 mm) of insulation having a conductivity not exceeding 0.27 Btu per inch/h \times ft² \times °F (1.53 W per 25 mm/m² \times K). The first 8 feet (2438 mm) of piping in noncirculating systems served by equipment without integral heat traps shall be insulated with 0.5 inch (12.7 mm) of material having a conductivity not exceeding 0.27 Btu per inch/h \times ft² \times °F (1.53 W per 25 mm/m² \times K).

504.6 Hot water system controls. Automatic-circulating hot water system pumps or heat trace shall be arranged to be conveniently turned off automatically or manually when the hot water system is not in operation.

504.7 Pools. Pools shall be provided with energy conserving measures in accordance with Sections 504.7.1 through 504.7.3.

504.7.1 Pool heaters. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

504.7.2 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar-and waste-heat-recovery pool heating systems.

504.7.3 Pool covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

Exception: Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

SECTION 505 ELECTRICAL POWER AND LIGHTING SYSTEMS (Mandatory)

505.1 General. (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications, and minimum acceptable lighting equipment for exterior applications.

Exception: Lighting within dwelling units.

505.2 Lighting controls. (Mandatory). Lighting systems shall be provided with controls as required in Sections 505.2.1, 505.2.2, 505.2.3 and 505.2.4.

505.2.1 Interior lighting controls. Each area enclosed by walls or floor-to-ceiling partitions shall have at least one manual control for the lighting serving that area. The required controls shall be located within the area served by the controls or be a remote switch that identifies the lights served and indicates their status.

Exceptions:

1. Areas designated as security or emergency areas that must be continuously lighted.
2. Lighting in stairways or corridors that are elements of the means of egress.

505.2.2 Additional controls. Each area that is required to have a manual control shall have additional controls that meet the requirements of Sections 505.2.2.1 and 505.2.2.2.

505.2.2.1 Light reduction controls. Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Lighting reduction shall be achieved by one of the following or other approved method:

1. Controlling all lamps or luminaires;
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps;
3. Switching the middle lamp luminaires independently of the outer lamps; or
4. Switching each luminaire or each lamp.

Exceptions:

1. Areas that have only one luminaire.
2. Areas that are controlled by an occupant-sensing device.
3. Corridors, storerooms, restrooms or public lobbies.
4. Sleeping unit (see Section 505.2.3).
5. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).

TABLE 504.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY (input)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED ^{a, b}	TEST PROCEDURE
Water heaters, Electric	≤ 12 kW	Resistance	0.97 - 0.00132V, EF	DOE 10 CFR Part 430
	> 12 kW	Resistance	1.73V + 155 SL, Btu/h	ANSI Z21.10.3
	≤ 24 amps and ≤ 250 volts	Heat pump	0.93 - 0.00132V, EF	DOE 10 CFR Part 430
Storage water heaters, Gas	≤ 75,000 Btu/h	≥ 20 gal	0.67 - 0.0019V, EF	DOE 10 CFR Part 430
	> 75,000 Btu/h and ≤ 155,000 Btu/h	< 4,000 Btu/h/gal	80% E _t (Q/800 + 110√V) SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h	< 4,000 Btu/h/gal	80% E _t (Q/800 + 110√V) SL, Btu/h	
Instantaneous water heaters, Gas	> 50,000 Btu/h and < 200,000 Btu/h ^c	≥ 4,000 (Btu/h)/gal and < 2 gal	0.62 - 0.0019V, EF	DOE 10 CFR Part 430
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
	≥ 200,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E _t (Q/800 + 110√V) SL, Btu/h	
Storage water heaters, Oil	≤ 105,000 Btu/h	≥ 20 gal	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	> 105,000 Btu/h	< 4,000 Btu/h/gal	78% E _t (Q/800 + 110√V) SL, Btu/h	ANSI Z21.10.3
Instantaneous water heaters, Oil	≤ 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 2 gal	0.59 - 0.0019V, EF	DOE 10 CFR Part 430
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
	> 210,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	78% E _t (Q/800 + 110√V) SL, Btu/h	
Hot water supply boilers, Gas and Oil	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E _t	ANSI Z21.10.3
Hot water supply boilers, Gas	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and ≥ 10 gal	80% E _t (Q/800 + 110√V) SL, Btu/h	
Hot water supply boilers, Oil	> 300,000 Btu/h and < 12,500,000 Btu/h	> 4,000 Btu/h/gal and > 10 gal	78% E _t (Q/800 + 110√V) SL, Btu/h	
Pool heaters, Gas and Oil	All	—	78% E _t	ASHRAE 146
Heat pump pool heaters	All	—	4.0 COP	ARI 1160
Unfired storage tanks	All	—	Minimum insulation requirement R-12.5 (h-ft ² -°F)/Btu	(none)

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements. In the EF equation, V is the rated volume in gallons.

b. Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, Q is the nameplate input rate in Btu/h. In the SL equation for electric water heaters, V is the rated volume in gallons. In the SL equation for oil and gas water heaters and boilers, V is the rated volume in gallons.

c. Instantaneous water heaters with input rates below 200,000 Btu/h must comply with these requirements if the water heater is designed to heat water to temperatures 180°F or higher.

505.2.2.2 Automatic lighting shutoff. Buildings larger than 5,000 square feet (465 m²) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:

1. A scheduled basis, using time-of-day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m²) and are not more than one floor; or
2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or
3. A signal from another control or alarm system that indicates the area is unoccupied.

Exception: The following shall not require an automatic control device:

1. Sleeping unit (see Section 505.2.3).
2. Lighting in spaces where patient care is directly provided.
3. Spaces where an automatic shutoff would endanger occupant safety or security.

505.2.2.2.1 Occupant override. Where an automatic time switch control device is installed to comply with Section 505.2.2.2, Item 1, it shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.
4. Allows the lighting to remain on for no more than 2 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m²).

Exceptions:

1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time may exceed 2 hours.
2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled may not exceed 20,000 square feet (1860 m²).

505.2.2.2.2 Holiday scheduling. If an automatic time switch control device is installed in accordance with Section 505.2.2.2, Item 1, it shall incorporate an automatic holiday scheduling feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.

Exception: Retail stores and associated malls, restaurants, grocery stores, places of religious worship and theaters.

505.2.3 Sleeping unit. Sleeping units in hotels, motels, boarding houses or similar buildings shall have at least one master switch at the main entry door that controls all permanently wired luminaires and switched receptacles, except those in the bathroom(s). Suites shall have a control meeting these requirements at the entry to each room or at the primary entry to the suite.

505.2.4 Exterior lighting controls. Lighting for all exterior applications shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by an astronomical time switch. Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. Astronomical time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

Exception: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

505.3 Tandem wiring. (Mandatory). The following luminaires located within the same area shall be tandem wired:

1. Fluorescent luminaires equipped with one, three or odd-numbered lamp configurations, that are recess-mounted within 10 feet (3048 mm) center-to-center of each other.
2. Fluorescent luminaires equipped with one, three or any other odd-numbered lamp configuration, that are pendant- or surface-mounted within 1 foot (305 mm) edge-to-edge of each other.

Exceptions:

1. Where electronic high-frequency ballasts are used.
2. Luminaires on emergency circuits.
3. Luminaires with no available pair in the same area.

505.4 Exit signs. (Mandatory). Internally illuminated exit signs shall not exceed 5 Watts per side.

505.5 Interior lighting power requirements. (Prescriptive). A building complies with this section if its total connected lighting power calculated under Section 505.5.1 is no greater than the interior lighting power calculated under Section 505.5.2.

505.5.1 Total connected interior lighting power. The total connected interior lighting power (watts) shall be the sum of the watts of all interior lighting equipment as determined in accordance with Sections 505.5.1.1 through 505.5.1.4.

Exceptions: The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.

1. Specialized medical, dental and research lighting.
2. Professional sports arena playing field lighting.

- 3: Display lighting for exhibits in galleries, museums and monuments.
4. Sleeping unit lighting in hotels, motels, boarding houses or similar buildings.
5. Emergency lighting automatically off during normal building operation.

505.5.1.1 Screw lamp holders. The wattage shall be the maximum labeled wattage of the luminaire.

505.5.1.2 Low-voltage lighting. The wattage shall be the specified wattage of the transformer supplying the system.

505.5.1.3 Other luminaires. The wattage of all other lighting equipment shall be the wattage of the lighting equipment verified through data furnished by the manufacturer or other approved sources.

505.5.1.4 Line-voltage lighting track and plug-in busway. The wattage shall be the greater of the wattage of the luminaires determined in accordance with Sections 505.5.1.1 through 505.5.1.3 or 30 W/linear foot (98W/in m).

505.5.2 Interior lighting power. The total interior lighting power (watts) is the sum of all interior lighting powers for all areas in the building covered in this permit. The interior lighting power is the floor area for each building area type listed in Table 505.5.2 times the value from Table 505.5.2 for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type as listed in Table 505.5.2. When this method is used to calculate the total interior lighting power for an entire building, each building area type shall be treated as a separate area.

505.6 Exterior lighting. (Mandatory). When the power for exterior lighting is supplied through the energy service to the building, all exterior lighting, other than low-voltage landscape lighting, shall comply with Sections 505.6.1 and 505.6.2.

Exception: Where approved because of historical, safety, signage or emergency considerations.

505.6.1 Exterior building grounds lighting. All exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lumens per watt unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section 505.6.2.

**TABLE 505.5.2
INTERIOR LIGHTING POWER ALLOWANCES**

LIGHTING POWER DENSITY	
Building Area Type ^a	(W/ft ²)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Healthcare-Clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multi-Family	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail ^b	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

- a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.
- b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or 1.6 W/ft² times the area of the specific display but not to exceed 50% of the floor area, or 3.9 W/ft² times the actual case or shelf area for displaying and selling jewelry, china or silver, shall be added to the interior lighting power determined in accordance with this line item.

505.6.2 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power allowances based on the densities permitted in Table 505.6.2 for these applications plus an additional unrestricted allowance of 5 percent of that sum. Tradeoffs are allowed only among exterior lighting applications listed in Table 505.6.2 in the Tradable Surfaces section. Exterior lighting for all applications (except those included in the exceptions to Section 505.6.2) shall comply with the requirements of Section 505.6.1.

Exceptions: Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

1. Specialized signal, directional, and marker lighting associated with transportation;

2. Advertising signage or directional signage;
3. Integral to equipment or instrumentation and is installed by its manufacturer;
4. Theatrical purposes, including performance, stage, film production and video production;
5. Athletic playing areas;
6. Temporary lighting;
7. Industrial production, material handling, transportation sites, and associated storage areas;
8. Theme elements in theme/amusement parks; and
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

**TABLE 505.6.2
LIGHTING POWER DENSITIES FOR BUILDING EXTERIORS**

APPLICATIONS	LIGHTING POWER DENSITIES
Tradable Surfaces (Lighting Power Densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs, and outdoor sales areas may be traded.)	
Uncovered Parking Areas	
Parking Lots and drives	0.15 W/ft ²
Building Grounds	
Walkways less than 10 feet wide	1.0 watts/linear foot
Walkways 10 feet wide or greater, plaza areas and special feature areas	0.2 W/ft ²
Stairways	1.0 W/ft ²
Building Entrances and Exits	
Main entries	30 watts/linear foot of door width
Other doors	20 watts/linear foot of door width
Canopies and Overhangs	
Canopies (free standing & attached and overhangs)	1.25 W/ft ²
Outdoor Sales	
Open areas (including vehicle sales lots)	0.5 W/ft ²
Street frontage for vehicle sales lots in addition to "open area" allowance	20 watts/linear foot
Nontradable Surfaces (Lighting Power Density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the Tradable Surfaces section of this table.)	
Building facades	0.2 W/ft ² for each illuminated wall or surface or 5.0 Watts/linear foot for each illuminated wall or surface length
Automated teller machines and night depositories	270 watts per location plus 90 watts per additional ATM per location
Entrances and gatehouse inspection stations at guarded facilities	1.25 W/ft ² of uncovered area (covered areas are included in the Canopies and Overhangs section of Tradable Surfaces)
Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft ² of uncovered area (covered areas are included in the Canopies and Overhangs section of Tradable Surfaces)
Drive-up windows at fast food restaurants	400 watts per drive-through
Parking near 24-hour retail entrances	800 watts per main entry

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

505.7 Electrical energy consumption. (Mandatory). In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

**SECTION 506
TOTAL BUILDING PERFORMANCE**

506.1 General. The proposed design complies with this section provided that:

1. Sections 502.4, 502.5, 503.2, 504 505.2, 505.3, 505.4 505.6 and 505.7 are each satisfied, and
2. Annual energy costs of the proposed design as determined in accordance with Section 506.3 do not exceed those of the standard design as determined in accordance with Section 506.4.

506.2 Analysis procedures. Sections 506.2.1 through 506.2.8 shall be applied in determining total building performance.

506.2.1 Energy analysis. Annual (8,760 hours) energy costs for the standard design and the proposed design shall each be determined using the same approved energy analysis simulation tool.

506.2.2 Climate data. The climate data used in the energy analysis shall cover a full calendar year (8,760 hours) and shall reflect approved coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location.

506.2.3 Energy rates. The annual energy costs shall be estimated using energy rates published by the serving energy supplier and which would apply to the actual building or *DOE State-Average Energy Prices* published by DOE's Energy Information Administration and which would apply to the actual building.

506.2.4 Nondepletable energy. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the proposed design. The analysis and performance of any nondepletable energy system shall be determined in accordance with accepted engineering practice using approved methods.

506.2.5 Building operation. Building operation shall be simulated for a full calendar year (8,760 hours). Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays, and any seasonal operation. Schedules shall model the time-dependent variations of occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage, and any process loads.

506.2.6 Simulated loads. The following systems and loads shall be modeled in determining total building performance: heating systems, cooling systems, fan systems, lighting power, receptacle loads, and process loads that exceed 1.0 W/ft² (W/0.0929 m²) of floor area of the room or space in which the process loads are located.

Exception: Systems and loads serving required emergency power only.

506.2.7 Service water-heating systems. Service water-heating systems that are other than combined service hot water/space-heating systems shall be omitted from the energy analysis provided all requirements in Section 504 have been met.

506.2.8 Exterior lighting. Exterior lighting systems shall be the same as in the standard and proposed designs.

506.3 Determining energy costs for the proposed design. Building systems and loads shall be simulated in the proposed design in accordance with Sections 506.3.1 and 506.3.2.

506.3.1 HVAC and service water-heating equipment. All HVAC and service water-heating equipment shall be simulated in the proposed design using capacities, rated efficiencies and part-load performance data for the proposed equipment as provided by the equipment manufacturer.

506.3.2 Features not documented at time of permit. If any feature of the proposed design is not included in the building permit application, the energy performance of that feature shall be assumed to be that of the corresponding feature used in the calculations required in Section 506.4.

506.4 Determining energy costs for the standard design. Sections 506.4.1 through 506.4.7 shall be used in determining the annual energy costs of the standard design.

506.4.1 Equipment efficiency. The space-heating, space-cooling, service water-heating, and ventilation systems and equipment shall meet, but not exceed, the minimum efficiency requirements of Sections 503 and 504.

506.4.2 HVAC system capacities. HVAC system capacities in the standard design shall be established such that no smaller number of unmet heating and cooling load hours and no larger heating and cooling capacity safety factors are provided than in the proposed design.

506.4.3 Envelope. The thermal envelope of the standard design shall comply with the prescriptive requirements of Sections 502.1 through 502.3, as well as the mandatory provisions of Sections 502.4 through 502.5.

506.4.4 Identical characteristics. The heating/cooling system zoning, the orientation of each building feature, the number of floors and the gross envelope areas of the standard design shall be the same as those of the proposed design except as modified by Section 506.4.5 or 506.4.6.

Exception: Permanent fixed or movable external shading devices for windows and glazed doors shall be excluded from the standard design.

506.4.5 Window area. The window area of the standard design shall be the same as the proposed design, or 35 percent of the above-grade wall area, whichever is less, and shall be distributed in a uniform pattern equally over each building facade.

506.4.6 Skylight area. The skylight area of the standard design shall be the same as the proposed design, or 3 percent of the gross area of the roof assembly, whichever is less.

506.4.7 Interior lighting. The lighting power for the standard design shall be the maximum allowed in accordance with Section 505.5. Where the occupancy of the building is not known, the lighting power density shall be 1.5 Watts per square foot (16.1 W/m²).

506.5 Documentation. The energy analysis and supporting documentation shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. The information documenting compliance shall be submitted in accordance with Sections 506.5.1 through 506.5.4.

506.5.1 Annual energy use and associated costs. The annual energy use and costs by energy source of the standard design and the proposed design shall be clearly indicated.

506.5.2 Energy-related features. A list of the energy-related features that are included in the proposed design and on which compliance with the provisions of the code are claimed shall be provided to the code official. This list shall include and prominently indicate all features that differ from those set forth in Section 506.4 and used in the energy analysis between the standard design and the proposed design.

506.5.3 Input and output report(s). Input and output report(s) from the energy analysis simulation program containing the complete input and output files, as applicable. The output file shall include energy use totals and energy use by energy source and end-use served, total hours that space conditioning loads are not met and any errors or warning messages generated by the simulation tool as applicable.

506.5.4 Written explanation(s). An explanation of any error or warning messages appearing in the simulation tool output shall be provided in a written, narrative format.

CHAPTER 6 REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 107.

Standard reference number	Title	Referenced in code section number
AAMA American Architectural Manufacturers Association 1827 Walden Office Square Suite 550 Schaumburg, IL 60173-4268		
AAMA/WDMA/CSA 101/I.S.2/a440-05	Specifications for Windows, Doors and Unit Skylights	402.4.2, 502.4.1

Standard reference number	Title	Referenced in code section number
AMCA Air Movement and Control Association International 30 West University Drive Arlington Heights, IL 60004-1806		
500D-98	Laboratory Methods for Testing Dampers for Rating	502.4.4

Standard reference number	Title	Referenced in code section number
ANSI American National Standards Institute 25 West 43rd Street Fourth Floor New York, NY 10036		
Z21.10.3-01	Gas Water Heaters, Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating Tank and Instantaneous—with Addenda Z21.10.3a-2003 and Z21.10.3b-2004.	Table 504.2
Z21.13-04	Gas-Fired Low Pressure Steam and Hot Water Boilers	Table 503.2.3(5)
Z21.47-03	Gas-Fired Central Furnaces.	Table 503.2.3(4)
Z83.8-02	Gas Unit Heaters and Gas-Fired Duct Furnaces—with Addendum Z83.8a-2003.	Table 503.2.3(4)

Standard reference number	Title	Referenced in code section number
ARI Air Conditioning and Refrigeration Institute 4301 North Fairfax Drive Suite 200 Arlington, VA 22203		
210/240-03	Unitary Air-Conditioning and Air-Source Heat Pump Equipment	Table 503.2.3(1), Table 503.2.3(2)
310/380-93	Standard for Packaged Terminal Air-Conditioners and Heat Pumps	Table 503.2.3(3)
340/360-2000	Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment.	Table 503.2.3(1), Table 503.2.3(2)
365-02	Commercial and Industrial Unitary Air-Conditioning Condensing Units	Table 503.2.3(6)
460-00	Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.	Table 503.2.3(11)
550/590-98	Water Chilling Packages Using the Vapor Compression Cycle—with Addenda.	Table 503.2.3(7)
70-00	Absorption Water Chilling and Water Heating Packages	Table 503.2.3(7)
3256-1 (2004)	Water-source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-air and Brine-to-air Heat Pumps.	Table 503.2.3(2)
1160-2004	Performance Rating of Heat Pump Pool Heaters	Table 504.2

REFERENCED STANDARDS

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329-2305

Standard reference number	Title	Referenced in code section number
119—88 (RA 1994)	Air Leakage Performance for Detached Single-family Residential Buildings	Table 404.5.2(1)
146-1998	Testing and Rating Pool Heaters	Table 504.2
13256-1 (2004)	Water-source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-air and Brine-to-air Heat Pumps (ANSI/ASHRAE/IESNA 90.1-2004)	Table 503.2.3(2)
90.1—2004	Energy Standard for Buildings Except Low-rise Residential Buildings (ANSI/ASHRAE/IESNA 90.1-2004)	501.1, 501.2, 502.1.1, Table 502.2(2)
ASHRAE—2004	ASHRAE Handbook of Fundamentals-2004	402.1.4, Table 404.5.2(1), 503.2.1
ASHRAE—2004	ASHRAE HVAC Systems and Equipment Handbook-2004	503.2.1

ASME

American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Standard reference number	Title	Referenced in code section number
PTC 4.1 - 1964	Steam Generating Units	Table 503.2.3(5)

ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2859

Standard reference number	Title	Referenced in code section number
C 90—03	Specification for Load-bearing Concrete Masonry Units	Table 502.2(1)
E 96—00e01	Standard Test Methods for Water Vapor Transmission of Materials	202, 502.5
E 283—04	Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen	402.4.3, 502.4.2, 502.4.7

CSA

Canadian Standards Association
5060 Spectrum Way
Mississauga, Ontario, Canada L4W 5N6

Standard reference number	Title	Referenced in code section number
101/I.S.2/A440—05	Specifications for Windows, Doors and Unit Skylights	402.4.2, 502.4.1

CTI

Cooling Technology Institute
2611 FM 1960 West, Suite H-200
Houston, TX 77068-3730

Standard reference number	Title	Referenced in code section number
ATC-105 (2000)	Acceptance Test Code	Table 503.2.3(11)
STD-201 (2002)	Certification Standard for Commercial Water Cooling Towers	Table 503.2.3(11)

DOE

U.S. Department of Energy
 c/o Superintendent of Documents
 U.S. Government Printing Office
 Washington, DC 20402-9325

Standard reference number	Title	Referenced in code section number
10 CFR Part 430, Subpart B, Appendix E (1998)	Uniform Test Method for Measuring the Energy Consumption of Water Heaters	Table 504.2
10 CFR Part 430, Subpart B, Appendix N (1998)	Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers	Table 503.2.3(4), Table 503.2.3(5)
DOE/EIA-0376 (Current Edition)	State Energy Prices and Expenditure Report	404.3, 506.2.3

HI

Hydronics Institute, Division of the Gas Appliance Manufacturers Association
 P.O. Box 218
 Berkeley Heights, NJ 07054

Standard reference number	Title	Referenced in code section number
HBS	I=B=R—Testing and Rating Standard for Heating Boilers, 1989 Ed.	Table 503.2.3(5)

ICC

International Code Council, Inc.
 5203 Leesburg Pike, Suite 600
 Falls Church, VA 22041-3401

Standard reference number	Title	Referenced in code section number
IBC-06	International Building Code®	102.2, 201.3
ICC EC-06	ICC Electrical Code®	201.3
IFC-06	International Fire Code®	201.3
IFGC-06	International Fuel Gas Code®	201.3
IMC-06	International Mechanical Code®	503.2.5, 503.2.6, 503.2.7.1, 503.2.7.1.1, 503.2.7.1.2, 503.2.9.1, 503.3.1, 503.4.5
IPC-06	International Plumbing Code®	201.3
IRC-06	International Residential Code®	201.3, 403.2.2, 403.6, 404.6.1, Table 404.5.2(1)

IESNA

Illuminating Engineering Society of North America
 120 Wall Street, 17th Floor
 New York, NY 10005-4001

Standard reference number	Title	Referenced in code section number
90.1-2001	Energy Standard for Buildings Except Low-rise Residential Buildings	501.1, 501.2, 502.1.1, Table 502.2(2)

NFRC

National Fenestration Rating Council, Inc.
 8484 Georgia Avenue
 Suite 320
 Silver Spring, MD 20910

Standard reference number	Title	Referenced in code section number
100-01	Procedure for Determining Fenestration Product U-Factors—Second Edition	102.1.3
200-01	Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence—Second Edition	102.1.3
400-01	Procedure for Determining Fenestration Product Air Leakage—Second Edition	402.4.2, 502.4.1

SMACNA

Sheet Metal and Air Conditioning Contractors National Association, Inc.
4021 Lafayette Center Drive
Chantilly, VA 20151-1209

Standard reference number	Title	Referenced in code section number
SMACNA—85	HVAC Air Duct Leakage Test Manual	.503.2.7.1.3

UL

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096

Standard reference number	Title	Referenced in code section number
181A—98	Closure Systems for Use with Rigid Air Ducts and Air Connectors — with Revisions through December 1998	.503.2.7
181B—95	Closure Systems for Use with Flexible Air Ducts and Air Connectors —with Revisions through August 2003	.503.2.7
727—98	Oil-Fired Central Furnaces—with Revisions through January 2001	Table 503.2.3(4)
731—95	Oil-Fired Unit Heaters—with Revisions through January 1999	Table 503.2.3(4)

WDMA

Window and Door Manufacturers Association
1400 East Touhy Avenue, Suite 470
Des Plaines, IL 60018

Standard reference number	Title	Referenced in code section number
101/I.S.2/A440—05	Specifications for Windows, Doors and Unit Skylights	.402.4.2, 502.4.1

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ISBN 1-58001-270-1



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